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[OFFICIAL NOTICE.]

Bound Volume, Proceedings New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
OFFICE OF THE SECRETARY,
NEW BEDFORD, MASS., Oct. 26, 1901.

A limited number of copies of the "Proceedings" of the New England Association of Gas Engineers, for the years 1900 and 1901, remain, and single copies can be obtained on application to the Secretary, who will mail them on receipt of $2.

This volume contains several papers and the discussions thereon, and are of especial value for reference. The "Proceedings" of prior years will be published later, and the volumes will be of great value for any gas man's library.

N. W. GIFFORD, Secretary.

BRIEFLY TOLD.

"RETORT OVENS AS PRODUCERS OF ILLUMINATING GAS."—In the JOURNAL for November 11th, p. 767, was printed the text of the paper, read by Mr. Thomas Littlehales, of Syracuse, N. Y., at the Boston meeting of the American Gas Light Association, who wrote on the subject of "Retort Ovens as Producers of Illuminating Gas." The current issue of the JOURNAL contains an abstract of the discussion that was had on the paper; and it may be truthfully said that both paper and discussion were interesting; the paper, if for nothing else, for its audacity, and the discussion for its pointedness. Mr. Littlehales has served a lengthy period in the gas making business in different parts of North America, and heretofore has been considered quite a conservative gas engineer; for in his prior statements for public recording anent current gas practice (and such statements have been fairly frequent at the meetings of the American Gas Light Association) no wording of revolutionary preaching can be found. In accounting, then, for his sudden change of attitude, in moving so far from his former lines, it is possible that environment is the reason. That is to say, the opinions of Mr. Littlehales as manager of a regularly organized and methodically operated gas company quite differ from the opinions held by Mr. Littlehales as an adherent of a great manufacturing concern, like the Semet-Solvay Company, for instance In this we do not mean for an instant to imply that Mr. Littlehales' opinions or beliefs are purchasable, for an acquaintance with him covering quite more than the span allotted to a generation has been our satisfaction; but we do mean to say that, in his present championing of "retort ovens as producers of illuminating gas," his usual deliberateness has given place to feverish energy. As far as the main point is concerned—as to whether or not the beehive oven is superior to the Semet-Solvay retort oven—gas men of themselves care little; the nourishment in the egg for them being will either answer their purpose for the economical manufacture of gas, no matter what becomes of the coke. We will admit that Mr. Littlehales avers that the Syracuse form is the form above all others, and we will also admit that he makes a good strong plea for it as a coke maker; but we will all have to wait

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NOV 25 1901

until its merit has been shown from an economical point to the gas maker and seller. Possibly that illustration will in the end be shown in Syracuse, the gas works of which seem to stand pretty close to the rehabilitating point in several directions. Passing from the paper (which on its face shows how much time and thought Mr. Littlehales must have put into its preparation) to the discussion, one cannot fail to find a note of dissent running all through the speeches against the thoughts advanced by Mr. Littlehales. "Will it pay?" That was the mooted question, and we think the shots fired by Mr. A. S. Miller, Mr. Walter R. Addicks, Mr. C. H. Nettleton and Mr. Malcolm S Greenough were sufficiently hot for Mr. Littlehales' interception. Messrs. Miller, Addicks and Nettleton, from propinquity to the Everett (Mass.) district, know full well how things have fared and are faring there, and likely Mr. Greenough is also posted thereon, as he still has many friends in the East. In fact, with the latter we inquire: "What does the financial market say about the coke plant at Everett?" And we inquire further: "How do the Trustees of the concern feel over their painful duty in being obliged to make the next interest payment in December?" It may be to some a case of bringing the mountain to Mahomet or of causing Mahomet to go to the mountain; but to the average gas maker the problem is which is the better division of his enterprise—to make and sell gas as his primal aim, or to make and sell coke, tar and ammonia, with gas as the secondary consideration? Speaking for our section of the country, gas *per se* is sufficiently attractive on business account to keep its makers and sellers alert and active, and it is further certain that the people in charge of the engineering division of the gas supply of this district are not disposed to put themselves at the mercy of any set of coke makers, no matter how, when or where the coke is made. And as it is here with the legitimate gas industry so should it be with the legitimate gas industry in every other section of the country.

PERSONAL.—With much satisfaction we note that our contemporary the *Engineering and Mining Journal*, under its new proprietorship, has satisfactorily arranged its editorial staff. David T. Day, Ph.D., whose services for 16 years as Chief of the Division of Mining and Mineral Resources of the United States Geological Survey, have had world-wide recognition; has been named as Editor in Chief; Mr. Edward W. Parker has been appointed Managing Editor; and the Associate Editor is Mr. Frederick Hobart, whose good work on the paper for the last 8 years does not require commendation from us. Mr. Lucius S. Bigelow is the General Manager of the publication. These names are sufficient guarantee that the *Engineering and Mining Journal*, the fame of which as an independent, reputable technical publication has never been smirched, will go on over the broad, fair road mapped out for it long ago by Rossiter W. Raymond, Ph.D., M.E., who we are pleased to add will remain on the *Journal's* staff as a special contributor. Good luck to you all, gentlemen.

ELECTRIC GAS LIGHTING.—This is the title of a book recently issued from the press of Messrs. Spon & Chamberlain of this city. It is the work of Mr. H. S. Norrie, and his work is done well. It is only a small affair, but within its less than 100 pages proper, which carry no fewer than 57 illustrations, diagrams and drawings, one can readily glean all that is needful regarding the installing of electric gas igniting apparatus, especially for use in houses, stores, schools, etc. A summary of the contents of its chapters is appended: 1. Introduction. Means of producing spark induction. Induction coils. 2. Application of induction coils to gas lighting. Forms of burners used, pendant, rachet, stem, Welsbach, automatic, and for gasoline and acetylene. 3. How to connect up apparatus. Wiring a house. Locating breaks or short circuits. Wiring in finished houses. General remarks. 4. Primary coils and safety devices. 5. How to wire and fit up different systems for lighting of large buildings. 6. The selection of suitable batteries for gas lighting, repairs, maintenance, etc. The price of the book is 50 cents.

NOTES.—Proposals for the public lighting of Jersey city, N. J., for 1 year, from December 1, 1901, will be opened to-morrow.——The Consolidated Street Railway Company, of Mobile, Ala., has applied for the right to construct and operate a gas works there. This concern owns all the lighting and traction systems of Mobile, save the Mobile Gas Light Company, and it could secure the latter's property if it would pay a *fair* price for it.——The Consolidated Gas Company, of Baltimore, Md., is preparing to extend its mains to and through the adjoining district of Hampden.

[LIMITED ABSTRACT - CONCLUDED FROM PAGE 807.]

PROCEEDINGS TWENTY-NINTH ANNUAL MEETING AMERICAN GAS LIGHT ASSOCIATION.

HELD AT STEINERT HALL, BOSTON, MASS., OCTOBER 16 TO 18, 1901.

SECOND DAY—THURSDAY, OCT. 17—AFTERNOON SESSION.

The Association reconvened at 2 P.M. The President introduced Mr. Thomas Littlehales, of Syracuse, N. Y., who read a paper on

RETORT OVENS AS PRODUCERS OF ILLUMINATING GAS.[1]

[For the text of Mr. Littlehales' Paper, see JOURNAL, Nov. 11th, 1901, page 767.]

Discussion.

Mr. Atwater expressed his gratification at hearing so hearty an indorsement of the retort oven as a gas producer from an engineer of the wide experience of Mr. Littlehales, and welcomed the nomenclature used by him in terming them "retort ovens." The author's closing statement, which was in effect that where there is a market for first class foundry coke at good prices the retort oven would produce gas at a lower price than the gas retort was not as hopeful as his array of facts would justify, and limited the retort oven to a very small field outside of the furnace coke precincts. Good coke, sufficient for all the requirements of the modern blast furnace, is now made in retort ovens, but there were comparatively few localities where retort ovens making blast furnace coke could be placed in which their full gas capacity would find satisfactory outlet. Nor was the field limited by the market for foundry coke, the volume of this business not being sufficient to make the industry of importance in itself, or to affect the gas field one way or another. The introduction of coke in domestic use, in railroads and industrial establishments to replace soft coal and anthracite would be necessary to bring the retort oven into the gas field. The probability of doing this could be judged by the success of the Everett (Mass.) Works in disposing of 1,200 tons of coke per day for the past year; and the plants now in course of erection for the Hamilton (O.) Otto Coke Company, and the South Jersey Gas, Electric and Traction Company proved that gas men did not regard this success as ephemeral. He believed that in the average town, where there existed a minimum daily demand for the surplus gas from at least 50 retort ovens, and where the community already consumed enough solid fuel to give the equivalent coke a fair chance for introduction on its merits, the retort oven would justify its existence.

Mr. Egner said that the by-product coke or "retort ovens," as Mr. Littlehales styled them, had already attracted the attention of notable men in the gas industry. The great question was, "Would it pay?" He was inclined to take for granted any statements made by Mr. Little-

1. To the Littlehales' paper, as originally printed, the following paragraphs should be inserted directly ahead of the third paragraph from the end of the argument:

"It is, I think, a mistake to assume that the gas is, under all conditions, the most valuable product of the coal. That is entirely a matter of condition, and very largely a matter of locality. The beehive oven men evidently do not hold that view, because their methods prove that they consider not only the gas but the tar and ammonia practically valueless; and it may really be so under their conditions and methods of working, because their operations are too far from the gas market.

"For generations past engineers have looked regretfully at the enormous power of Niagara Falls going to waste, and have figured what could be done with it if they only had it placed just where they wanted it. And it is only recently, as we all know, that practical effect has been given to the self-evident proposition that it is easier to establish factories near Niagara than it is to remove the Falls. May not an analogous condition be brought about in the coke trade to a large extent? When it is borne in mind, as stated in my paper, that the quantity of coal used in coke making in the United States is 14 times larger than that used in coal gas making in 435 cities and towns, and that not only is all the coke therefrom readily marketed, but the demand is increasing to such an extent as to necessitate the building of hundreds of additional ovens every year, and as a very large portion of the coke so produced is shipped to various parts of the country, it seems to me more a matter of decentralization of the coke industry than anything else. In localities where there are a considerable number of foundries or where there can be established an opening for the coke for locomotive fuel, for general steam raising, or other purposes, it is to my mind a matter beyond question that ovens can be operated to earn a larger percentage of profits on the outlay than retorts can.

"It is not possible to take the mountain to Mahomet, may it not be found possible to take Mahomet to the mountain; and, further, may not Mahomet himself be much benefited by such an excursion? We cannot remove our towns and cities to the centers of coke production, but I see no reason why, to a large extent, the coke making should not be conducted at points where the by-products can be more readily marketed with advantage to all interests concerned."

hat's on any subject to which he had given careful consideration, even though he might entertain a different opinion; but he thought that some of the figures given in the paper might be questioned. It was stated that in these coke ovens a ton of coal could be carbonized for 20 cents, while the cost in gas works was about 90 cents per ton. Using ordinary horizontal retorts with machine stoking, the cost of labor could be brought down to 25 cents per ton; and with inclined retorts the cost would go below 20 cents; and, if the cost of apparatus were considered, the balance would be in favor of the inclined retort system.

Mr. A. S. Miller said that, on first reading, the paper seemed a severe indictment against gas men for slighting a wonderful improvement. But although there was a large waste of gas near where furnace coke was used, no figures had ever been given by Mr. Shelton, whom Mr. Littlehales quoted, to show that this gas could be profitably piped to a distance and used, or which demonstrated that this could be done and the gas saved to advantage. Assuming a cost of 40 cents per 1,000 cubic feet in the holder, the 4,000 cubic feet of gas which Mr. Littlehales gave as the amount recovered from a ton of coal would represent $1.60, available to pay freight on the coal and coke. If the coal was hauled one way and the coke carried back, that amount would pay for the round trip over 180 miles. How many cities could be reached within 180 miles of the blast furnaces? Mr. Atwater's proposition that a market must be made for the coke when the gas was to be sold was entirely different from that of Mr. Littlehales. According to the former, there must be a gas consumption and hard fuel consumption equal to the capacity of 50 retort ovens. On a basis of 6 tons of coal per oven per day and 4,000 cubic feet of gas per ton, this gives 1,200,000 cubic feet of gas per day. How many gas companies in this country could sell this amount of gas even if they deducted the total cost of the gas in the holder from their present selling price?

Mr. Addicks suggested that there might be more in favor of coke ovens, and perhaps more difficulty in the way of their introduction and use, than Mr. Littlehales had pointed out. The output from 50 retort ovens, suggested by Mr. Atwater as being sufficient to justify the existence of the retort oven in the average towns, was the minimum and not the maximum output. The maximum output would vary in different parts of the country. In putting in their ovens it would be necessary to have auxiliary works to supply the difference in output for the winter months, and the cost of gas was to be determined, not only by the cost of that gas in the coke ovens but must include the additional cost of the necessary auxiliary plant. In making this statement he referred only to a gas business, and not to a coke business. Undoubtedly the coke oven could be placed and do business on a coke basis solely; but he was speaking only to gas engineers who contemplated the introduction of coke ovens, and who must consider all these points in determining each for himself what could be done in his own town. He had a number of questions which he desired to ask Mr. Littlehales, but would take no exception if he declined to answer them. Among the questions were these: Assuming the usual per cent. of sulphur in a good American coal, how many grains of fixed sulphur, by Mr. Littlehales' process, would there be in 100 cubic feet of gas before purification? How many grains of fixed sulphur in gas, when using coal having a large proportion of sulphur as compared with good American coal? Referring to the statement that 4,000 feet of surplus gas could be practically obtained from all the coal that was coked in the State of Pennsylvania, how was the number of feet of surplus gas in any place determined, and during what period of days, and if, during the period of observation, there was any change in the heats in the oven? At what time of year and in what place were the observations made? Is the percentage of surplus gas a constant independent of the quality of the coal, and independent of the quantity of volatile constituents, and of the heat unit value in the total gas? How many hours were the ovens run on surplus gas, and how many hours on gas for heating the ovens, when giving 4,000 feet of surplus gas? What would be the effect on the price of residuals if all gas works were to set up coke ovens? In making each 10,000 cubic feet of illuminating gas, how many pounds of coke, how many gallons of tar, and how many pounds of sulphate of ammonia could be sold? What effect on the surplus gas has the making of a hard metallurgical coke as compared with the making of a comparatively soft coke?

Mr. Nettleton thought that although Mr. Littlehales firmly believed all he said in the paper it might be that he was mistaken in some things. The one question was can the coke be sold? The Everett people stated freely that the works there were primarily a coke works and that the residuals in order of value were, tar, ammonia and gas. If the coke from a ton of coal could be readily sold for the value of the coal, and the other residuals were at the prices that prevailed a year ago, the coke oven would be a more attractive proposition than it now was, with the difficulty experienced in selling coke at paying prices and the uncertainty as to the value of the other residuals.

Mr. Seymour asked Mr. Littlehales to designate more particularly what he called "Gas works of moderate size;" also, what would be the smallest number of ovens which could be worked economically; and what would be the cost of building those?

Mr. Greenough had no prejudice against the use of gas made in this way, or in any other way, in which money could be made. If new works were about to be erected he would certainly put in retort ovens if he could see any advantage in making gas in that way. He did not want to put himself on record as controverting the position taken by Mr. Littlehales as to the greater economy of coke ovens, but he did not consider that that claim to greater economy had yet been proven; and he did not think such positive statements should be suffered to go out without protest, unless members of the Association agreed with what had been said. Taking Mr. Littlehales' own statements, as to the cost of handling a ton of coal, the saving in labor claimed, and the value of the residuals obtained by the use of his process, and comparing those figures with the results obtained in the ordinary methods, the balance did not appear to be in favor of the coke oven. Before assenting to the statement that the coke oven was to be the future method of gas making, he wanted to see the figures which indicated the profitable running of such works. What did the financial market say about the coke plant at Everett? What were its bonds and stock selling for? Were they worth what they had been put on the market for? Had the Glassport (Pa.) works paid a dividend? And was its coke satisfactory? Could coke out of those retort ovens be as readily sold for domestic purposes as gas retort coke? Ton for ton he knew that the porous gas retort coke was the better coke of the two for domestic use. He had nothing to say against retort furnaces in their own departments; he would not suggest that they were not valuable adjuncts to a blast furnace, or in any large iron works in which they made their own coke; nor would he say anything against the quality of the coke—he was simply referring to the manufacture of gas from those ovens; but he could not admit that it had been shown that this was the better way for any gas company to build new gas works.

Mr. Searle said that the paper might not only fill gas men with consternation, but was likely to fill the manufacturers of fertilizers with consternation, in that the retort oven plan on the wholesale scale could not fail to bring about a great overproduction of sulphate of ammonia, with a consequent decided shrinkage in the market value thereof.

Mr. Littlehales said that he appreciated the criticism and comment that his paper had elicited. He knew he had fairly made himself a target, and if he had received even hotter shot he would still consider that he was fairly a mark for it. He believed the coke oven could be made a success in any locality where there was a demand for coke for foundry or other purposes, and that it could be made a success on a much smaller scale than would be supposed. He thought that, under the conditions named by Mr. Atwater, an installation of much smaller size than 50 ovens would justify its existence. The pertinent consideration with every gas man should be the method for earning the best dividend on the capital intrusted to him, and he cared not whether such dividends were earned by making water gas or coal gas, or by coke making. He would change the method from one basis to another if thereby he could earn a larger return on the capital of his Company, and it was from that standpoint he had considered the coke oven. He purposely understated the quantities of tar and ammonia produced in the ovens so as to enable comparisons to be made on a perfectly safe basis from the oven side of the question. In matter of fact at least as much ammonia was obtained as in the best gas works practice, although not as much tar was made; but he was satisfied to have the tar more conveniently and profitably disposed of in the distillation. As to Mr. Miller's thoughts, Mr. Littlehales said he could not regard it as any reflection on the gas engineers of the past or of the present that, in their constant efforts to improve methods of manufacture so as to cheapen the product, they should occasionally strike on something that had not before had the showing it deserved. Regarding his remarks about Mr. Shelton's position on the distribution of gas under high pressure, as th speaker recalled the statements made in two papers which had been read by Mr. Shelton before two different Associations, his words were in effect that while no photometric tests had been made, those engaged in the operation could distinguish with the eye no loss in illuminating power. While he did not believe it possible to deliver gas at any considerable distance without some loss, yet for the past 25 years in the city of London, gas has been conveyed a distance of about 16 miles with but little loss of candle power, and that little loss had been provided

for in an inexpensive manner. He was sorry he could not answer all of the questions put by Mr. Addicks, but would reply to his general proposition by stating that, as far as the sulphur was concerned, there would be practically no difference in the sulphurous condition of the gas, in either the retort or the coke oven, when made from the same coal. As to the coke oven requiring an auxiliary plant, he would say that one of the difficulties the system first suggested to him, was the lack of elasticity about it; but, as a matter of fact, it had more elasticity than one would suppose. The oven could as well be heated by producer gas as by gas from retorts, wherefore, all of the gas made in the oven could be used for lighting; and it could be done economically. A tumble in the price of ammonia had been predicted as likely to result from the general adoption of this system, but the fertilizer manufacturing industry was not the only one to create a demand for ammonia. Cold storage and other branches of manufacture create a demand for ammonia, and he did not think there was any occasion to worry about the market for that residual. Within the last few years a great stimulus had been given to the use of tar by the making of tar macadam roads, and wherever such roads were introduced all the tar that could be produced would find a ready market. One of the greatest capacities in coke for foundry purposes was that it must be of such a dense character as to be incapable of being crushed by the weight of iron in the furnace; and coke distilled under the weight of 6 feet of coal would be of denser character than that distilled under a weight of only 20 inches, as in the beehive oven. In conclusion, what he wanted gas men to mainly consider was the problem of changing from the gas to the coke side of the question as the more important financial consideration.

Mr. Shelton said that personally he did not care for the criticisms which had been made as to high pressure distribution of gas, but he did not want a false impression as to the success of such workings to go out because of his failure to reply to the comments which had been made. It was true that he had not gone with any great particularity into some of the details of the question of high pressure distribution; and it was true that neither he nor anyone else had yet proved that gas could be satisfactorily distributed under pressure at the distances that would be called for by the general proposition of Mr. Littlehales. Still he thought it had been satisfactorily proved that gas could be successfully carried a number of miles, with small pipes, under comparatively high pressure, where heretofore they had scarcely used more than a number of inches in large expensive pipes. He was not yet ready to state that coke oven gas could be carried under pressure 200 miles; but for short distance work, and he believed ultimately for considerable distances, high pressure could be used; and he wanted to go on record as emphasizing that point.

Mr. Littlehales said when he referred to Mr. Shelton's remarks he had no idea of *distributing* under high pressure, but that gas could be conveyed in bulk from the generating plant to a central distributing station, from whence it could be sent out in the usual way.

The President introduced Mr. Charles F. Prichard, of Lynn, Mass., who read a paper on

THE FUEL VALUE OF RESIDUALS.

[For the text of Mr. Prichard's paper, see JOURNAL, Nov. 18, 1901, p. 807.]

Discussion.

Mr. Sherman stated that for several years he had been using oil gas tar under retort furnaces. The furnaces burned 66 bushels of coke and 3 barrels, or 150 gallons of oil gas tar in benches of 6's. Naming the coke value as 6 cents per bushel the tar for burning would seem to be worth $1.32 per barrel.

Mr. Nettleton said that the paper demonstrated, in both a theoretical and a practical way, the absolute value of residuals for fuel purposes, and was thus of great service to all who were in the gas business.

In reply to inquiries made by Mr. Norris and Mr. Donahue, Mr. Sherman stated that at New Haven the oil was put in with a steam atomizer. A start was made with a coke fire, but coke was not again used after the fire had been started. There was no trouble in keeping it burning, although there was some trouble with smoke if the valves were not opened.

Mr. Norris inquired how Mr. Prichard defined "breeze." Was it screened? And what was the size of the mesh?

Mr. A. S. Miller stated that he had experimented somewhat in his works in a like direction and the results given by Mr. Prichard indicated that his own results had not been far wrong. He had always figured on the tar having theoretically a little higher heating power, but the figures given by Mr. Prichard indicated that the tar had not the heating power that he had supposed.

Mr. Donahue inquired with regard to the smoke when burning tar. Mr. Prichard's paper showed a tar burner with secondary air admitted to setting at the bridge wall. Had he at any time been troubled with smoke at the stack outlet, or was that merely a question of the regulation of the air?

Mr. Egner said he had found that in firing benches a gallon of tar was equal to two-thirds of a bushel of coke. He had burned the tar without any perceptible smoke.

It was a surprise to Mr. Norris that anybody should expect to get smoke in burning tar.

Mr. Donahue knew that with extreme care there need be no smoke; and he inquired if, in cases of ordinary working of Mr. Prichard's system, there would be smoke coming out of the stack.

Mr. Holmes inquired if there was any nicety of adjustment in introducing the tar; or did it flow by and through specific gravity?

Mr. Prichard replied that the screen through which the coke was put was the ordinary 12-tine tanner's fork. There were no pieces of coke that were over ⅝ of an inch. The breeze used in the tests was refuse from the coke yard. He had had no trouble with smoke from burning tar. At the burner the tar burned with a clean, white flame and without smoke. The tar was let in by gravity from a small tank on top of the boiler. The water gas tar ran nicely and required very little care. Coal gas tar was thicker and gave a little more trouble, but there was seldom a stoppage. Its use relieved the fireman of a great deal of work.

The President introduced Mr. Walton Forstall, of Philadelphia, who read the following short topic on

A COMPARISON OF STANDARDS FOR CAST IRON PIPE AND SPECIALS.

What follows is written in reply to the letter of the Secretary of this Association, under date of February 27th, 1901, asking whether the standards of the Association adopted in 1898 were approved of and would be used, and if not, what suggestions could be made looking to the improvement of these standards.

General Differences.—The writer proposes here to discuss the differences between the standards of the Association and those now in use by the United Gas Improvement Company.

For simplicity we will hereafter call the former the "A" standards and the latter the "B" standards. Should anyone desire to have his pipe and specials made by the "A" system, the only data as far as the writer knows to which he could refer the manufacturer are contained on pages 77 to 91, inclusive, Volume 15, of the Association Proceedings. The "B" system is shown in a handbook of 73 pages, printed in 1900 by the United Gas Improvement Company, entitled "Specifications for Cast Iron Pipe and Special Castings." Now, if the idea of the Association in presenting its standards was that they should be used as far as they went, and for specials not shown the members should design for themselves or take what the manufacturers offered, then the criticisms which follow do not hold; but if it was thought that in the pages of the Proceedings mentioned above would be found all the specials required for gas work, then the writer believes it is easy to show incompleteness in the "A" standards, and this he will proceed to do in discussing the various classes of specials. For convenience of reference the specials will be taken up in the order in which they are found in the Proceedings.

Bell and Spigot Details.—Fig. 1 shows very clearly, on full scale, the differences in bells and spigots of the two systems; the hatched sections representing the "A" standards and the plain sections the "B" standards. As will be seen at once the "B" system provides for three larger sizes than that of the "A," and certainly any changes made by the Association should provide for standards up to 48 inches, the sizes added to the present ones being 36 inches, 42 inches and 48 inches. The 40 inches shown on Fig. 1 is peculiar to Philadelphia, pipe of that size having been laid by the Bureau of Gas, but the writer considers it an odd size and not be recommended for use.

The first impression obtained from looking at Fig. 1 is that, for sizes from 3 inches to 8 inches inclusive, the "B" sections are much heavier than the "A." The extra thickness of the pipe just back of the bell is in accord with good foundry practice, and lessens the liability of "checking" at this point. The whole idea has been to provide so much metal at the bells that the chance of cracked bells, due to caulking or any other strain, would be reduced to a minimum, and with our present practice of using heavy pipe, as for instance, 30 pounds to the foot for 6 inches, it would seem but consistent to be sure of the strength of the bell. This is especially true in regard to the 3-inch and 4-inch sizes, although it is to be hoped that practically no 3-inch is ever put underground, except for repair work.

For the sizes above 8 inches, the two sections more nearly approach

each other in shape, the "A" ones being actually larger than the "B" in width of bell at face, but still lacking in thickness at the bottom of the bell, though the difference in the case of the 30 inches is negligible

The depth of the bell is the same for both systems, except for 12 inches and 16 inches, where the "B" bells are 4½ inches in depth, as against 4 inches for the "A." Here again the argument is that the ½ inch is warranted by the greater security it affords of tightness of joint, it being always remembered that more and more under city conditions it is impossible to lay pipe just as one would wish to, and that, therefore, there are many cases where joints must be broken a good deal, making the deep bell of value.

The great length of bead given to the "A" pipe is, supposedly, designed to care for the impurities which sometimes collect in the spigot end, the idea being that with the "A" bead the lower portion of it at least will be solid. The advantages of a solid bead, as far as the chances of gas leaking through it are concerned, do not especially appeal to the writer, because it seems to make little difference how the gas gets behind the lead in a joint, whether between the spigot and the bell through the yarn, or through the spigot and the yarn, for in any case it is the lead which is to be the final stop. Therefore, if the writer is correct, and the "A" form of bead is to counteract the effect of impurities, it would seem to be a remedy for something which is not bad enough to warrant such a cure. It ought to be understood that in case of large pipe there is always enough metal in the pouring gate above the end of the pipe to care for the greater amount of impurity that will be found in a large mass of iron, and that, therefore, the beads of large pipe are no more honeycombed than those of small ones. The disadvantages of the "A" bead would seem to be the deep annular ring between the bead and the inside of the bell, forming a space which probably never gets properly filled with yarn, and the poor opportunity afforded to drive the yarn home because of the blunt surface offered by the concave face of the bead. The "B" bead on the other hand has a comparatively long bevel towards the face of the bell and the yarn is more easily wedged tight between the bead and the bell.

The consideration of the differences between the lead rings of the two systems is left to a later portion of the paper.

Three-way Branches.—The "A" system of 3-way branches (which we shall hereafter denote by tees for the saving of breath) provides for 3-bell fittings only, both eccentric and center outlets being shown. The writer is very much in favor of using 3-bell fittings wherever possible, as the result is to diminish the number of spigot pieces left over from any job, but as far as his experience goes it has never been possible, except at the cost of extra joints, to always use 3-bell fittings, and, therefore, the "A" system should provide for 2-bell tees with a choice of 2 lengths at the spigot end, as is done by the "B" system. The use of center outlets, or, in other words, the cases where center outlets are preferable to eccentric ones, have been so rare in the writer's experience that it was not thought necessary to include them in the "B" system and so far there has been no reason to think their omission a mistake.

A comparison of the small details of design between the tees of both systems does not disclose any important differences, but the "B" design seems to offer a little less opposition to the flow of gas, and this remark applies to crosses as well.

Four-way Branches.—In the "A" system for 4-way branches or crosses, only all bell fittings are arranged for, center and eccentric outlets both being provided. The remarks as to the necessity for 1 spigot end on the run of the fitting made in respect to tees applies to crosses also, and the "A" system is incomplete as it now stands.

In both crosses and tees, the use by the "A" system of $\frac{6}{16}$-inch metal for 3-inch and $\frac{8}{16}$-inch for 6-inch is not to be recommended; $\frac{8}{16}$-inch and $\frac{7}{16}$-inch respectively being preferred.

Reducers.—The "A" standards show concentric reducers only, making it impossible to drain a larger into a smaller main without a certain amount of condensation being trapped. The "B" standards on the contrary provide for eccentric reducers and allow for bells on either the large or small end, or for spigots on both ends or bells on both ends. While it may be urged that in most cases the last two classes of all spigot or all bell reducers savor of an unnecessary refinement, there is no question that the eccentric reducer is much preferable to the concentric, and that in practice there is need for 2 classes, those with bell on small end and those with bell on large end. Both systems allow for about as many reductions in one piece, and in designing a system to suit everyone it will of course be well to provide for every pattern that could be asked for, although not often required for ordinary use. For instance, in practice, it seems that the reduction of 2 sizes, as from 12 inches to 6 inches in 1 reducer, is all that is necessary, and a change from 20 inches to 6 inches could be made by using 20 inches to 12 inches and 12 inches to 6 inches, but there might be occasions when it would be extremely inconvenient to have 2 joints in a change from 20 inches to 6 inches, and the system should provide a pattern from which a 20-inch to 6-inch reducer could be ordered.

Plugs.—The form of plug shown in the "A" standards appears to be the same for all sizes. In designing the "B" system, it was thought advisable to provide plugs for convenience in handling heavy plugs on all sizes 12 inches and larger. This, of course, is a detail upon which no two people might agree.

Drip Pots.—Again the charge of incompleteness seems just in regard to the "A" standards. Under city conditions there are so many cases where drips are necessarily close together that it is not reasonable to use as large a size pot in those cases as it would be in draining long lines, as would be the case in country places or in the suburbs of a large city. Therefore, at least 2 sizes of pot for every size bell should be provided. The design of the top of the "A" drip pot appears weak, and there is no apparent reason why the opening should be made as large as it is.

Bends.—The "A" standards provide for bell and spigot bends in the 3 classes shown, to the naming of which serious exception should be taken, the (ordinarily named) 90° bends being called "full bends," the 45° "half bends," and the 22½° "quarter bends." There is no inherent advantage in such a system of naming worth the confusion that would result until most of us had managed to remember that a "quarter bend" was no longer quarter of a circle or 90°, but was 22½° bend, being a quarter of what was arbitrarily called a "full bend." In discussing these bends the usual names will be used.

The "B" system provides for bell and spigot bends in all 3 classes, with a choice of 2 different lengths of spigot, and in addition in sizes 4 inches to 12 inches inclusive for double bell or double spigot bends. Much practice under city conditions has proven to the writer that there is a wide field of usefulness for these double bell and double spigot bends, especially in the 4-inch and 6-inch sizes of the 45° bends, and many neat pieces of work under trying conditions could never have been made if the "A" standards had alone been available.

The radii of curvature of the "A" bends are longer than those of the "B," and this may be an advantage from the standpoint of gas flow. Where long and gradual curves are required, the "B" system makes use of a circle bend with a 5-foot radius forming the arc of a circle with a deviation of 60°.

Sleeves.—The "A" standards provide for but two lengths of sleeve, 9 inches and 12 inches. To show the necessity in the larger sizes for a longer sleeve than here provided, let us consider the case of a sleeve joint to be made on a 30-inch main, the depth of bell in which according to these standards is 4¾ inches. The piece to fit the gap must be cut say ¼ inch shorter in order to allow for play, so that when it has gone home on the bell or the spigot, as the case may be, there is a gap of 4½ inches plus ¼ inch, or 5 inches. Therefore, the 12-inch sleeve will cover a space of 3½ inches of iron at one end, 5 inches of air at the middle, and 3½ inches of iron at the other end. Of course, the air space can be wrapped with sheet iron, but at the same time, with the short amount of projection at each end of the pipe into the sleeve, and with the perfectly straight sleeve shown by the "A" standards, there being no key-ring, it is reasonably sure that the sleeve joint will be the worst in the line. Besides this, our supposition infers that both ends of the gap are exactly square with each other, something which seldom obtains in large pipe. In many cases when we join 30 inches with a sleeve of the "A" system there would be at certain points in the circumference not more than 2 inches of iron projecting into the sleeve. Therefore, the lengths of the sleeves should vary according to the size of main, and the writer's ideas of correct dimensions is shown by the "B" system, where a 36-inch sleeve is 18 inches long and a 2-inch sleeve 8 inches long. You will note that the "A" system does not provide for 2-inch sleeves. Unfortunately all companies still have 2-inch mains in existence, and while they are being replaced as fast as possible, it is often necessary to use in repair work 2-inch sleeves both solid and split.

The remarks as to length of sleeves applies to split as well as solid, the extra length of the split sleeves being often very valuable in covering a long break. There seems no reason why a key ring should not be provided for in sleeves as well as for ordinary bells, and in the "B" system, besides doing this, slight projections have been designed for sleeves 16 inches and over in size, to act as some kind of a stop to the yarn.

These remarks not being designed to tell in detail how specials should be constructed, the question of the number of bolts or other details of split sleeves will not be considered.

Flanged Pieces.—The writer does not intend to discuss flanged spec-

ials, as they are practically never used in street main work, and if the "A" standards are supposed to cover flanged pipe, there are a number of specials which go with such work that ought to be included.

Various Omissions.—The "A" standards do not provide for the following specials: Bushings, which have already been described in a former paper of the writer's; hub sleeves, which are split sleeves provided with hubs of various sizes and are designed for connecting large to small mains; service sleeves, which are split sleeves strengthened by a boss through which are tapped holes of various sizes, and designed for the connection of large services to small mains; hat flanges, which are designed for the connection of small mains to very large ones; and curtain drips. The foregoing criticisms of the "A" standards are the writer's reasons for not using them, and his suggestions above for their improvement could be embodied in the one statement to substitute the "B" standards. At the same time, the latter system while meeting the requirements of the company for which it was designed would have to be broadened before adoption by the Association. The writer believes that the only way to design a set of standards which will be used by the members of the Association is to put in charge of such work a committee drawn from those interests which require the largest amounts of castings. A set of standards thus prepared, which will embody all the patterns thought necessary by such a committee, and which will be so complete that every information that the manufacturer wants as to the construction of his patterns can be obtained from the specifications and plans, will be very apt to come into universal use, because if the manufacturers are told that the large interests want their castings made according to these standards patterns will be changed accordingly, and because uniformity conduces to economy, the smaller buyers who take what is sent them will also be supplied from the standard patterns. A common standard in another branch of gas material was reached in just this way, viz., of the smaller buyers being given what the larger ones insisted on.

Discussion.

Mr. A. S. Miller said that the principal question should be not whether some other standard was as good as that which had been adopted by the Association, but whether some other standard was better. One of the main things bearing on the question of leakage was the lead crease. In designing that crease in the "A" standard the object had been to so form it that it would allow the lead to go in easily and at the same time keep it in. The "B" standard crease would apparently keep the lead from going into the joint, and make it easy for it to come out. The form of the bead had been taken from an old design. That was, however, a minor detail, and he knew of no one who was following that form exactly. In making detailed drawings it was found that there were many minor points which could not be followed; but it was found that the dimension from face to face of the bell, or from face to face of the flange, could be adhered to. It had not been the intention of the committee to limit the standards to the number of specials shown. For himself he would say that he would not be willing to adopt any standard and say that he would not use anything else where the standard would not fill the bill; although he would always use the standard wherever it was practicable to do so. He was in fact using the standards, but considered it quite proper to add to them as occasion demanded. Those who had the work in hand had not felt encouraged to extend the standards for the reason that they knew that the members of the Association did not generally use those which they now had. As to the number of hubs and spigots on specials, there should be standard bodies to hold the standard hub, flange or spigot, and then it would be only necessary to fit the parts together. If the standard was too light it could be strengthened. Minor dimensions could be changed without seriously interfering with the pattern; but if the general scheme was not right it had better be changed.

Mr. Walton Forstall said that his purpose had been to give the reasons for not using the Association's standards. He was not now prepared to give the reasons for not adopting the minor details, but would say that in the light of present knowledge he would advocate the lead crease of the Association rather than the one he now used. The easiest way to get the standards adopted was to make them perfect and complete. The more complete every detail could be made the more useful the standards would prove. He urged the appointment of a committee by the Association on the lines suggested in his paper.

Mr. A. E. Forstall said that the committee having the matter in charge had on it two members who represented probably the largest users of specials in the country, and would seem to fill all requirements.

A Telegram from Mr. Doty.

The President stated that he had a telegram from Mr. Paul Doty, expressing his regret at not being present to read his paper, entitled "The Analysis of Gas Accounts," and asking for that reason that the paper be withdrawn.

Report of Committee on Final Resolutions.

Mr. James Ferrier, of the Committee on Final Resolutions, presented the following report, which was adopted:

Your Committee on Final Resolutions beg to present the following: That the hearty thanks of the Association are due to the Committee of Arrangements for the thorough and successful manner in which they have striven to promote the comfort, the instruction and the entertainment of the members of the Association in their meeting in this historic city of Boston. Their labors have resulted in benefit both in and out of our sessions.

That the thanks of the Association should be tendered to the President and his coadjutor, the Secretary, for their able, impartial and businesslike conduct of the meetings.

That the thanks of the Association are owing to those members who have so successfully endeavored to demonstrate the advantages of membership in this Association, and have thus secured the gratifying increase recorded at this meeting.

That the Association owes its sincere thanks to those members who have prepared and presented the valuable papers read at this meeting, every one of which bears the stamp of hard work, and all of which are calculated to lighten the labors of gas managers.

James Ferrier,
I. C. Baxter, } Committee.
J. P. Harbison,

The convention was then declared adjourned.

The Economical Advantages of Inclined Retort Settings.

[By Mr. W. R. Herring, in *Journal of Gas Lighting.*]

I am afraid that the ultimate issue of the differences of opinion prevailing with regard to the economical advantages of inclined retorts, both from the capital and manufacturing costs point of view, has not been greatly assisted by the attention it has recently received; and that the primary object of the paper which I contributed to the proceedings of the International Engineering Congress, expressing a hope that at least some of these might be settled, has not been achieved. The short time at the disposal of the Chairman when the paper was read, prevented many who had had a more or less lengthened practical experience of the system from adding their say to what transpired on that occasion; and my object in again reverting to the matter is to endeavor to persuade them to place their experiences on record now, and enable the profession to get at the bottom facts of what, to me, has been the most important problem in the gas industry during the past 10 years.

I propose, first, to revert to the "Editorial Note," dealing with my paper which appeared in the issue of the *Journal* for October 1. In the second paragraph, there is reference to my paper read before the North British Association in July, 1900, in which I dealt somewhat fully with the various various characteristics of the different coals, and their relation to the angle of repose of same, and proceeded to show that the average angle best suited for the many differing characteristics of the material to be dealt with rendered it almost impossible that the same angle would be suitable for the automatic discharge of the coke. I therefore stated that it was absolutely necessary "that the angle of retort should be such as to permit of the coal lying evenly on the bed of the same without moving. Such an angle in the majority of cases is not sufficient to induce the coke to run without some exterior force being applied." I proceeded to suggest that there were instances when the charge required a mere pricking with a poker from the lower mouthpiece, which was "usually sufficient to induce the coke to run from the retort, particularly if the cross section of the retort has been such as to permit of the free expansion of coke without wedging in the crown of the same."

In the last part of the paragraph referred to in your "Editorial Note," you say that an engineer would be justified in not troubling with so questionable a system which possesses apparently irreconcilable differences to insure a successful working, "*especially in view of the possibilities of horizontal retorts worked mechanically.*" I propose to revert to the portion italicized hereafter, and in the meantime to take up the question of the automatic discharging of inclined retorts. Mr. Shoubridge claims that the system is perfectly automatic in its discharging; and I as distinctly aver, having inspected practically the whole of the inclined systems in this country and abroad, that it is not. Those having experience over a lengthened period with such installa-

tions, will be doing a service to the industry by expressing their candid opinions, one way or the other.

In my Congress paper, I suggested that not more than 50 per cent. of the mouthpieces would discharge automatically—meaning that, taking the life of a setting or an installation, about this number of the total charges would be automatically discharged, while the remainder would require some little assistance, small though it may be, sufficient to require the presence of a man on all occasions. There is no question about perfectly new settings running freely; but my mind dwelt rather upon the condition which the practical man usually finds—namely, more or less old ones. Mr. Shoubridge cannot be sincere when he suggests that the whole and sole secret of the automatic discharge is the charging appliances used. He has himself found it necessary to use tapered retorts, and also to attach the greatest importance to the form of the cross section of the retort. He has further honored me by adopting the section which I have had working in Edinburgh since 1898, and which was illustrated in connection with my paper in July, 1900.

I also referred to this section of retort, and to the necessity of preserving the same cross section to the outer lip of the mouthpieces, as far back as May 1 in the same year. The reference to this section in your recent article descriptive of the installation at the Crystal Palace Gas Works, suggests that it has been adopted for the first time in connection with that installation; whereas the object of this section was clearly defined by me as far back as May, 1900, and in my Congress paper I said that "with such a form the process will become as near automatic as it is possible to have it without introducing additional mechanical devices." This, I think, admits that the process is nearly automatic, but that it cannot be absolutely depended upon, and that occasionally additional assistance must be given to the contents of the retort, in order to insure its discharge and render it absolutely automatic. I therefore suggest that some further mechanical means can be easily introduced; and while I have not introduced them, my structional arrangements have been devised so as to permit of an application of mechanical force to accomplish this work. This suggestion appears to have seriously affected Mr. Shoubridge's idea of modern gas manufacturing practice. It is not, however, sufficient to condemn an idea simply because it appears to controvert an academical principle. Surely, as engineers, we are not to refrain from introducing mechanical appliances because superficially they may appear to complicate what is a simple process when performed by hand.

The pick and shovel are simple appliances; but the mechanical excavator—hideous in its appearance, and complicated in its structure—is admittedly more economical, not only in the expenditure of labor, but also in the matter of time required to perform a given operation. If, therefore, it can be shown that a mechanical appliance can be introduced to do what is at present performed by manual energy with the same or superior precision, it matters not how complicated the device may be, it is our duty to adopt it; our very existence as engineers depends upon it. We cease to deserve the title when we refrain from adopting the best possible means of reducing to the lowest minimum the present costs in connection with our manufacturing operations.

The cost of any appliance or installation should not be measured by the capital outlay involved in its establishment. This principle has held sway far too long in our country. The Americans have achieved their present pre-eminent position in the world by, so to speak, disregarding the first cost. It is the earning capacity of the money spent, represented by the appliances or installations which should be the governing factor; and provided its earning capacity is sufficient to pay interest charges and a proportionate sum for the liquidation of the capital and maintenance and upkeep of itself, it is our duty to expend the money rather than continue with imperfect plant and pay in wages sums that, in themselves, would be more than sufficient to meet such charges for capital, etc.

Mr. Shoubridge appears to be in this position, judging from your article referring to the Crystal Palace Gas Works. He admits the necessity of having two men on the charging stage of his installation. This is the very point I desired to bring out. In my Congress paper, when speaking of the centralized hopper as distinct from the continuous hopper system, I said that the localized hopper "necessitates the employment of additional labor to transfer the coal from the storage hopper to the particular retorts to be charged. There is also considerable loss of time in handling the charging appliances, as the charger has to carry the charge a certain distance in the retort house," propelled by manual labor. And as your article has it: "The charger being propelled with the utmost ease by the men on the stage, by means of bevelled gearing attached to the travelling wheels." The fact that Mr. Shoubridge requires two men on his charging stage conclusively proves this.

With the continuous hopper system (either with the attached measuring chamber or the charger itself acting as such, but not traversing with its load), one man alone is required on the stage to two men on the drawing stage. It is one of the two men on the drawing stage that I maintain can be dispensed with by introducing a simple mechanical device on the charging stage to give the contents of such retorts as are not self-discharging the necessary start or impetus, to induce the contents to flow into the coke conveyor or stage in front. In other words, one man on the drawing and charging stage, in place of Mr. Shoubridge's two men on each stage. As to the structural cost, I have already stated that this depends to a great extent upon the individuality of the designer, as well as upon the local conditions.

The larger question, as to the capital involved in a complete installation, comprising land, buildings and plant, as compared with a plant of equal capacity worked by horizontal machinery, is one that I am not at the present time prepared to go into; but I may do so at an early date. The principal point at issue at the moment appears to be the relative cost of the continuous overhead hopper system, as compared with the localized hopper.

Some of our constructing engineers will no doubt be able to give us very valuable comparisons under this heading; and it is to be hoped that they will place the information they have at the disposal of the *Journal*, so that the profession may have the advantages of it. I can, however, give you my own figures relative to the Granton works, from the schedules of quantities and weights, and which I may say have been accepted by the contractors as correct.

The hoppers complete weigh 161 tons 11 cwt.; and they cost £2,007 18s. They have a capacity of 800 tons, or, say, 20 hours' supply; the elevating plant working an 8-hour day. These hoppers are supported upon the transverse ties connecting the upper ends of the inner rows of the buckstays. A transverse tie in this position is a necessity, whether the hopper is supported therefrom or not. But to avoid dispute, I will add their cost (£269 8s. 8d.) to the former sum of £2,007 18s., and thus arrive at the total cost of storage hoppers and supports for a 1,000-ton per day plant of £2,277 6s. 8d. Interest at 5 per cent. on this sum amounts to, say, £114 per annum. The hoppers being constructed for a 1,000-ton plant, 200,000 tons of coal per annum will pass through them. The result is, therefore, 0.137d. per ton of coal for the capital outlay upon the continuous overhead hopper system, which, upon Mr. Shoubridge's own showing, will enable one man to do what he requires two for.

Surely to argue about capital costs under such conditions is the height of absurdity. Let someone give us the cost of his centralized hoppers. It will be found that the structural cost of one need be no greater than that of the other. At the same time, I again wish to distinctly point out that I look upon the capital cost as of secondary importance to the labor economy on the stage, which, on Mr. Shoubridge's own figures, would be only one-half of what it costs him, and would warrant him expending a further £3,600 in the construction of his hoppers—a sum which is out of all proportion to what would be necessary.

I again desire to refer to the last portion of the second paragraph of your "Editorial Note" of Oct. 1 (p. 830), wherein you refer to the possibilities of horizontal retorts worked mechanically. I think I may say that a clear issue has been rendered somewhat difficult, in consequence of occasional statements being made, wherein it is shown that mechanically charged horizontal retorts are being worked at approximately as low, and in some cases at a less, cost than similar installations on the inclined retort principle.

The late Mr. Frank Livesey, in his paper "A Comparison—Stoking Machinery or Inclined Retorts," remarked: "To arrive at the capital required, it will be necessary to decide what amount of work a set of machines is capable of doing per diem per shift;" and he went on to say that "the machine of Messrs. Foulis and Arrol, and those made by West's Gas Improvement Company, are both equal to charging 900 mouthpieces in 24 hours, or 75 charges every two hours, allowing plenty of time for rest between the charges for the men."

Mr. Tysoe, when speaking upon Mr. Carpenter's paper read before the Institution of Gas Engineers in May, 1900, stated that with machinery at his own works the cost, comparing mechanically charged horizontal retorts with inclined retorts erected by Mr. Carpenter, taking precisely the same items, and working under practically the same conditions, was 11.91d.—this figure presumably not including interest and depreciation charges, repairs, and sundries, such as are included in the figures given by Mr. Frank Livesey in his paper already referred to, and from which the following item of costs is taken. It is also interesting to note that while Mr. Frank Livesey gave the carbonizing wages with machinery at 18.8d., when the machinery was charging 900

mouthpieces in 24 hours. Mr. Tysoe gives 11.91d. when charging 600 mouthpieces.

In reply to a question put to Mr. Tysoe by myself—namely, "Will you give us the minimum amount of the gas made at the works where the cost comes out at 11.91d. per ton of coal carbonized? The machinery must be worked up to its full capacity to give such a result."—Mr. Tysoe said: "To make machinery successful, there must be a large works, and the machinery must be always at work. At my own works, the number of retorts served by one set of machinery amounts to 300—thirty beds of tens" (presumably 600 mouthpieces).

If these statements prove anything, I think it is certain that, under ordinary conditions, machinery cannot compare with the inclined retort system. Even in one or two isolated instances where horizontal machinery is worked under its very best conditions, and doing its maximum work throughout the whole year, the labor costs involved are no better than is being achieved by comparatively small installations of the inclined retort. Take, for instance, the installation at the Nelson Corporation works consisting of but a few settings of retorts. The carbonizing wages were certified by the late engineer (Mr. Alexander Allen), who took charge of the works after their introduction—and who, by the way, has had a most extensive experience with all classes of horizontal stoking machinery—to have been 10.3d. per ton, as against 1s. 5d. per ton when working with the best known horizontal machinery elsewhere. Testimony such as this cannot be brushed aside lightly: and the status of the profession demands, even apart from the interest of the industry, that as much light as possible should be thrown upon this subject now, so as to enable all to get at the bottom facts of the relative merits of our present systems.

I now desire to join issue with the writer of the "Editorial Note" already referred to, wherein the writer says: "The advantages of inclined retorts, it will on all hands be admitted, must stand comparison, not with what existed at one time, but with anything and everything with which the system might be brought into competition to-day. For example, Mr. Foulis was present when Mr. Herring read his paper; but he kept silence as to the terms upon which he would be able to solve the problem of carbonizing 1,000 tons of coal per day." Proceeding, it says: "It would not be by the principle of inclined retorts." Then if not, why not?

The bottom figures ever claimed for a retort house for a minimum plant of 6 million cubic feet a day, always at work, is, I think, by Mr. Tysoe, and stated to be 11.91d. Mr. Frank Livesey stated it at 18.8d., which latter figure agrees with most of our experiences. The bottom figure claimed for inclined retorts, and certified by a man who has had a very large experience with all sorts of horizontal machinery, is 10.3d. per ton, as against his best work with machinery at 1s. 5d. per ton.

I, among many others, also have my own experience to guide me as to the cost of working the various systems of present day carbonizing. I therefore contend that the suggestive phrase used by the writer "that the advantages of inclined retorts must stand comparison, not with what existed at one time, but with anything and everything with which the system might be brought into competition to-day" is correct only in the abstract; for the reason that the number of works where the working of stoking machinery is under its best conditions are so few as to render its economical introduction inapplicable to the general conditions of the gas industry as a whole. Even our large works, where the minimum day's output hovers around 5 million cubic feet, invariably have to produce it in two or three retort houses. On the other hand, it can be shown in several instances that even small works equipped with inclined retorts can compete, and easily beat, machinery working under its very best conditions.

Intze's Improvements in Gasholder Tanks.

Herr Otto Intze, according to the *Gas World*, has applied to the British Patent Office for protection in respect of "improvements in the construction of gasholder tanks." A fair resume of the specification lodged with the Patent Office is appended:

This invention relates to the construction of annular sheet metal tanks for gasholders which, especially in the case of tanks of large dimensions, presents various difficulties when it is desired to carry out the walls cylindrically in ordinary sheet metal construction. The outer cylindrical wall of an annular tank, being subjected to annular tension, must, for large gasholders, as also for ordinary full tanks, be strengthened to such considerable extent in the lower plates that the constructor is very much limited, as regards the diameter of the tank and the height of the walls, by the necessary thickness of the plates and also by the difficulty of fishing the joints of the plates without a too great expenditure of material and without weakening the joints too much by the rivet holes. The inner wall of an annular tank, being subjected to annular compression, requires, in order to secure against rupture, such a considerable expenditure of material that the strain resisting capacity theoretically calculated in the same is only slight compared with what would otherwise be considered as admissible.

The tendency of recent years to construct specially large tanks in metal, and, at the same time, to give the same the utmost possible stability whilst weighting or straining the ground as little as possible, has led to the present invention, which allows of very large diameters of tanks being chosen, and, at the same time, of the walls and other constructional parts being made of proportionately thin plates and not too heavy figure iron. The material can further be utilized up to its highest possible admissible strain resisting capacity, and the tank can be erected in a simple way, after the largest and heaviest elements of construction have been almost wholly prepared in the shops. The simplifying of the erection enables the necessary time for the same to be shortened, and the invention itself enables a much cheaper and more reliable carrying out of such constructions.

Fig. 1 is a vertical cross section of the tank. Fig. 2 is a horizontal section on line *CC* of Fig. 1. Fig. 3 is a vertical section on line *DD* of Fig. 1, or on line *EE* of Fig. 2. Fig. 4 shows a partial cross section of a modification of the tank. Fig. 5 is a horizontal section on line *FF* of Fig. 7. Fig. 6 is a vertical section on line *GG* of Fig. 7. Fig. 7 is a vertical section of a part of the lower portion of the tank. Fig. 8 is a plan view of the bottom of the tank as seen in the direction of the arrow *BB* in Fig. 1. Fig. 9 is a plan view of the framework supporting the tank bottom as seen in the direction of the arrow *AA* in Fig. 1.

The annular tank is constructed of elements concurrent to each other, each of which consists of 2 rolled or riveted vertical pillars, *A* and *B* (Figs. 1 and 4), and a horizontal girder, *C* (Figs. 1, 3, 4 and 7), binding the lower ends of these pillars. By the lower cross connection, *C*, of the pillars, the greater part of the water pressure, which, in the case of pillars only held above and below, bears with ⅔ of the complete column on the lower supporting points of the pillars, is, on the one hand, advantageously taken up, whilst, on the other hand, the forces of the radially oppositely placed pillars, which are directed in opposite directions to each other, are almost wholly equalized, so that heavy and costly annular bottom constructions are not necessary. The vertical pillars are connected horizontally at their upper ends, as in Fig. 1, and, if necessary, also between their upper and lower ends, as in Fig. 4, both exteriorly and interiorly, by means of rings *D* and *E*, or *F* and *G*, which offer the wall pillars the necessary support against the horizontal water pressure. The two vertical bays or spaces between two neighboring elements are closed by bulged or bent plates *H* (Figs. 1, 2, 4 and 6), the horizontal bottom space being likewise closed by a freely suspended, bent or bulged plate or by a flatly laid plate *K* (Figs. 1, 3 and 4). The inner and outer walls of the tank are thus formed by the plates *H*, and the bottom by the plates *K*.

As the bent or bulged plates, *H* and *K*, can receive a very small radius of curve or bend, the thicknesses required are only slight. Seeing, further, that the strength of the elements or frames formed by the pillars and the cross girder merely depends on the height of the wall or water column and on the distance of the elements from each other and that the thickness of the bent plates is merely dependent on the small radius of the bend, which is always kept the same size for tanks of varied sizes, and on the water column, it is not necessary to alter the strength of these elements and of the curved plates closing same with the diameter of the tank, and, in consequence, large diameters of annular tanks can be taken in hand which, hitherto, have not for practical reasons been used. Only the binding rings (Fig. 1) fitted to the upper ends of the wall pillars or the intermediate rings (Fig. 4) must be strengthened in proportion to the diameter of the tank.

Seeing, however, that at most a third of the horizontal water pressure on each wall pillar is transferred to the upper binding rings when the same are arranged alone, these rings can be constructed comparatively easily and safely, without requiring iron parts which, even in very large tanks, could not be joined in a simple manner. In this arrangement the upper parts, *L* and *M*, of the annular walls, which are under very little strain, can be constructed cylindrically of thick plates and can be advantageously made to serve as parts of the binding rings, *D* and *E*.

The form of the elements of the annular tank can be modified as is shown in Fig. 4, by the connection or binding of the vertical pillars at the lower end being effected by a sufficiently strong flat plate, *K*, which is supported directly by the foundation pillars. The resulting bulging out in opposite directions of the plates of the outer and inner walls of the tank, as in the present invention, allows, both during erection and

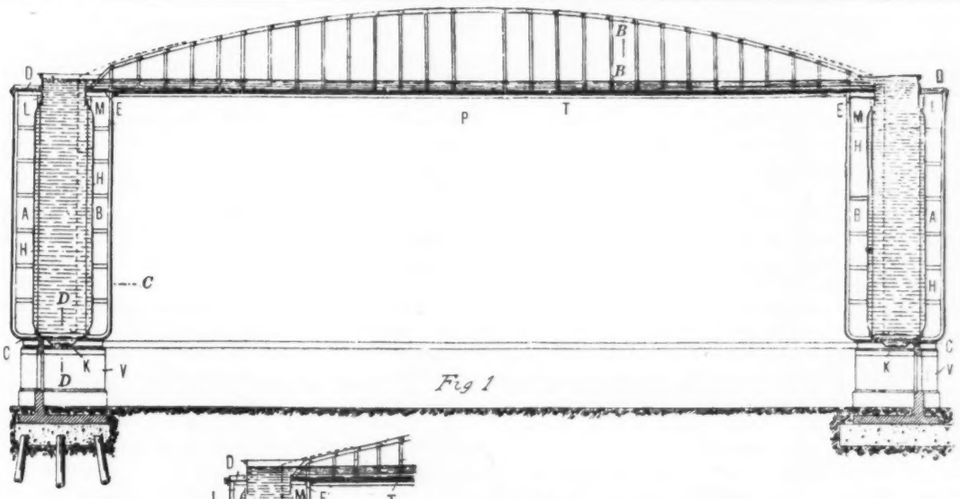

Fig 1

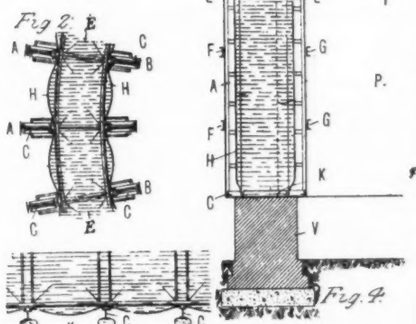

Fig. 4.

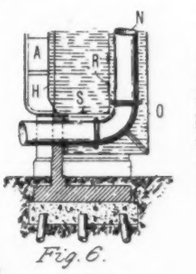

Fig. 6.

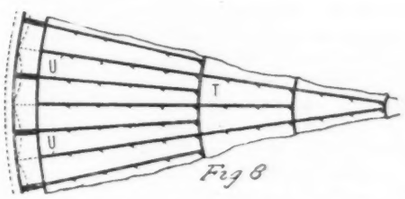

Fig 8

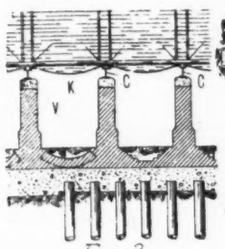

Fig. 3

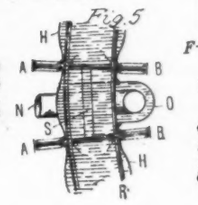

Fig. 5

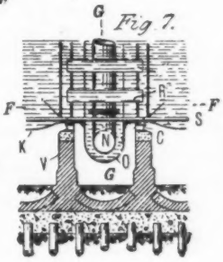

Fig. 7.

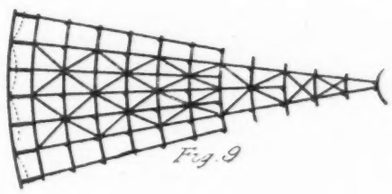

Fig. 9

also after the gasholder is finished, of the shell of the holder (shown in dotted lines in the drawings) and also the lower guide rollers being easily accessible.

In order to limit the width of the annular tank as much as possible, so far as the arrangement admits of this, the inlet and outlet pipes, *N*, for the gas are arranged in a special way. The bays or spaces between the particular two elements are extended at the bottom and on the inner wall of the tank by means of plates *O*, with a large bend. These plates are formed essentially like a half cylinder (Figs. 5, 6 and 7). By this arrangement it is made possible, even in very narrow annular tanks, to so carry very large inlet and outlet pipes through the extensions communicating with the water space of the annular tank and filled with water, that the pipes are not in the way of the holder and are yet completely covered by water which is part of the water of the annular tank itself. The complete immersion of the gas pipe, *N*, in water is necessary in order to prevent the escape of gas into the interior space, *P*, of the annular tank. It is also necessary that the water in which the gas pipe, *N*, is immersed be in permanent communication with the main water column filling the tank in order to be absolutely certain of the gas pipes being always fully immersed during the working of the gasholder.

The necessary transfer of the horizontal tractive forces which are exerted from the curved plates, *H* and *K*, of the neighboring bays on the parts of the elments of construction limiting the extensions is effected on the inner wall and at the bottom by horizontal flat irons, *R* or *S*, riveted at the ends (Figs. 5, 6 and 7). In order to reduce the weight of the water necessary for cutting off the gas from the accessible inner compartment, *P*, to a minimum, a freely suspended flat or slightly arched metal roof or cover, *T*, is arranged, which is brought as near to the water level of the tank as practical considerations render admissible. By this means it is made possible to reach any part of the cover from underneath and to tighten or pack the joints. The plates of the cover are first held in such way by advantageously radially placed girders, *U*, to which they are connected, that these girders, which are changeable in the direction of the center are located at distances from each other which are not greater than is admissible for the normal strain of the plates by the weight of water and by their own weight. Seeing the total weight coming on the unit of surface of the cover is almost everywhere the same, it is advantageous to suspend the cover or its girders in a framework which is made in the form of a spherical calotte or other rotary surface, and allows of an almost uniform utilization of the material. The cover frame which projects into the gasholder and which is connected with the cover by means of hangers is made so as to be secured against rupture by means of meridianal ribs, ring strips and diagonal stays lying in the rotary surface (Figs. 1 and 9). This framework of the cover serves at the same time for supporting the crown or dome of the gasholder when in its lowest position. The framework with the outer edge of the flat metal cover is supported in the upper binding ring, *E*, at the upper end of the inner pillars, *B* (Figs. 1 and 4). The meridianal pressure of the roof framework is counteracted in its vertical components by the wall pillars, *B*, of the inner wall, whilst the radial and outwardly directed horizontal components subject the binding rings, *E* (Figs. 1 and 4), to annular tension and thus advantageously relieve the binding ring subjected to compression strains by the water pressure against the inner wall.

Comparative calculations and worked-out constructional drawings have shown that the present invention, as above described, owing to the advantageous utilization of all the metal parts, admits of an essential reduction of the weight of large tanks compared with the hitherto usual construction. The weight supported by the supports of the present annular tank is so slight that the same can be in the form of single narrow pillars, *V* (Figs. 1, 3 and 7). By connecting the feet of these pillars, or by reversed arching between the pillars, the weight can be transferred to a continuous annular foundation of piles or concrete in such a way that the specific weight on the ground is extremely slight, and, on this account, the cost of the foundations for such tanks, as against the usual arrangements, is reduced materially.

The Duty of the Engineer to his Contractors and Employees.

[By Mr. L. Y. Schermerhorn.[1]]

For about 30 years of my life I was engaged as an engineer, in a practice sufficiently varied to bring me into contact with nearly all kinds of contractors. During the last 10 years of my life I have been more or less a contractor, and this, I think, permits me to speak at least in the light of experience on both sides of the question.

The proper presentation of the third subdivision of this topical discussion, or "The Duty of the Engineer to his Contractors and Employees," will be difficult to accomplish in the short time at my disposal. I therefore trust that this branch of the subject will be amplified in the general discussion which will follow.

The engineer in responsible charge is generally either the author of the plans and specifications upon which the work is to be carried into effect, or he is the employed agent of such author. In either case his relations to the contractor are the same. He is assumed to be an expert in the work which he designs or directs, and the assumption warrants the inference that his knowledge of the work in all its details is as great, if not greater, as that of the contractor. This assumption is justified by the usual declarations of the specifications, making the engineer the only recognized interpreter of the meaning of the plans and specifications for the work covered by the same.

No two engineering works are more than generally alike; and specific differences will exist that make each work a special study and almost a special design. Through the preliminary study given to the development of the plans and specifications the qualified engineer should be able to acquire a fuller knowledge of the details of the work than can generally be obtained by the contractor through means and time usually at the latter's disposal, between the issue of the plans and specifications and the tender of the contractor's proposal for the work. This establishes the fact that, except in simple and routine constructive work, the designing engineer has a better opportunity than the contractor to thoroughly familiarize himself with all the difficulties and uncertainties of the work. Therefore in this respect the designing engineer enjoys an advantage over the contractor which it is his duty to recognize, through the plans and specifications, by fairly placing before the contractor full information upon points which otherwise would escape the contractor's knowledge. His duty is something more than to vaguely suggest possible difficulties and requirements, and then create for himself a refuge, by ignoring all responsibility for lack of reliable data, by providing that the information upon essential points in the specifications is not guaranteed, and that the contractor through his personal knowledge and examination will be assumed as having full and correct information upon all matters involved in the work, even though the engineer may have suppressed a part of his information. It goes without saying that the contractor has, in the end, to assume such responsibilities; but it should be based as far as possible upon a full knowledge and frank avowal of all that the engineer knows of the work.

This duty of the engineer is a delicate one, and the personal equation of the individual will largely determine his action in the matter. Should his personal views be interfered with by those of his employer, then the engineer must determine for himself how far the ethics of his profession and his duties to himself and his fellow-man will rightly permit his judgment to be overruled by his superiors. To intentionally suppress important information which would be difficult or impossible for the contractor to obtain is at once a crime against the public and an error which is more than likely to assert itself unfavorably in the work with which it is connected. Dishonesty in the administration of work will surely result in dishonest execution, and this in turn may lead to disaster, involving both property and human life.

There never was an alleged wise saw that had less foundation in fact than than which states that "competition is the life of trade." If the word *death* were substituted for *life*, the statement would be nearer the truth. In nearly all callings, intelligence, ability, and its proper accompaniment reputation, count for much in winning business success. In the other professions we never hear of assignments made on the basis of competition; and yet the engineer is too often forced to carry into effect his plans under a system of unqualified competition that is at once destructive of good results and unfair to the contractor who will only do his work in a proper manner, and whose prices are based upon such a method of work as will insure satisfactory results to the engineer and to those for whom the work is done.

Open, unqualified competition, without reservation as to awards thereunder, is an invitation and an encouragement to the incapable, unwise, and dishonest contractor to enter into competion with the contractor who believes that capacity, experience, and honesty are essential elements both to his success and to the success of the work that is to be carried into execution. When incapacity, inexperience, and dishonesty are joined with political pull and favoritism, the premium placed upon the dishonest execution of work is such as to forbid competition on the part of contractors who do not adopt such methods.

The duty of the engineer under such adverse conditions is plain, for he must either be in a position to demand and secure the proper execution of the work intrusted to his charge, or he must retire himself from a responsibility which is almost sure to result in the dishonest execution of his plans and designs. The engineer owes at once a duty to his employees and the public, through which, by all legitimate means, the incapable and dishonest contractor is excluded from the possibility of competing for work to be done under the engineer's direction; and if it is impracticable to accomplish such an end by not allowing this class of contractors to bid upon work, the power and authority should be inherent in the specifications to permit the exercise of a discrimination which can be used to prohibit his securing the work.

The undesirability of unqualified competition is well recognized through the manner in which individuals and many large corporations invite proposals for required work or materials; viz., by placing their proposals only in the hands of such parties as are known to be capable, experienced, and honest. In the main, our cities and the general government are the only parties who do not adopt ordinary business methods in selecting their contractors, and where the only criterion is the lowest prices offered for the work to be done or the material to be furnished.

With the United States government this method of unrestricted competition is carried to the extreme, upon the theory that the bidder's or contractor's bond establishes the responsibility of the bidder or contractor; and more attention is given to very exact compliance with instructions as to the seals and notarial attestations upon the bonds than is given to the ascertainment of the fact whether or not the bonds have any real financial value. As a result of this method the government has constantly upon its public works failing and defaulting bidders and contractors, against whom legal action is seldom taken toward the enforcement of the penalties provided in the contract. While there may be a theoretic value in the moral effect of bonds and penalties named, such effect is lost upon the irresponsible and dishonest contractor, who through a long experience has gained a valuable knowledge of shrewd methods and tricks by which he can escape their enforcement, and upon which he fully counts when he enters into contract.

The engineer who is brought into administrative contact with the irresponsible and dishonest contractor will find himself quickly engaged in a conflict, whereby the efforts of the engineer to enforce the proper performance of the work will be met by every effort on the part of such a contractor to cheapen the work, or else to prepare the way for a successful escape from the penalties of his bond, if the work is not carried to satisfactory completion. The engineer who has gone through such experiences emerges from the conflict always a disappointed, but generally a wiser man.

From an experience of many years the speaker has been brought to feel that many engineers are inclined to hold a responsible and conscientious contractor to a more rigid enforcement, even of non-essentials, than an incapable and dishonest contractor to matters essential to the proper performance of the work. The reason for this is that it is easier to secure exact compliance from the former than even approximate compliance from the latter; but the question arises whether the engineer has a moral or professional right to attempt to move in such matters along the line of least resistance.

Considering the engineer as the direct agent of the parties who are to pay for the work done, it may not seem unnatural for the engineer to yield to the temptation of seeking the accomplishment of his work at the least possible cost to his employer, regardless of what he knows to be the real intrinsic value of the work. Adopting this view, some engineers encourage unqualified competition to its extreme, and attempt to reduce each letting of work to the methods and principles which surround the bargain counter.

Every work is worth its absolute cost as carried into proper execution under wise, economic, and efficient administration, plus a reasonable profit to the contractor. The engineer who seeks to accomplish his work at less than what he knows to be its true value violates the fundamental principles of sound business, and thereby lends himself to the perpetration of a fraud upon the public, and an injustice to his employer and his contractor.

1. Contributed by the author to the "Topical Discussion," proposed by The Engineers' Club, of Philadelphia, on the subject of "The Duty of the Engineer."

The engineer in responsible charge of work cannot give his unqualified time and attention to the details as they are carried out in the field; he therefore must delegate this duty of immediate supervision to his assistants or inspectors. Frequently this duty falls into more or less inexperienced hands, with the responsible engineer often far removed from the work, or else not easily accessible. The value is very great to the contractor and to the work of having at all times immediately accessible a representative of the engineer who, through training and experience, is qualified in an emergency to promptly act for his superior. Wisely as plans and specifications may be prepared, they are nevertheless not inspired and inerrant, and often the unexpected and unprovided-for contingency will arise that demands correct judgment and instant action, based on experience, and a large amount of level-headedness and common sense. If at such times the representative of the engineer does not possess these qualities, both the work and the contractor will be sufferers; and these are injuries the engineer has no moral or professional right to inflict on either the work or the contractor.

Carefully as plans and specifications may be prepared for works involving much detail, they can seldom provide for every variation from the normal which may occur; and when such variations do occur, the representative of the engineer who reads his specifications as though they were his Bible, expecting to find therein provision for all things, will surely be disappointed, and the work and the contractor will as surely suffer through the inspector's ignorance and misguided faith. No more unsatisfactory representative of the engineer can be found than he who is unable to call to his aid experience and common sense in interpreting the true spirit and intention of the plans and specifications.

It follows from these conditions that among the duties which an engineer owes to his contractor is that of being represented upon the work by an assistant who has other qualifications than those of being related to somebody, or one who votes on the right side, and who may, therefore, enjoy the favor of the district politician. An assistant or an inspector whose employment is based upon qualifications other than his fitness for the work, and whose tenure of office is not measured only by his capacity and known honesty, is an injustice to the contractor, and a standing menace to the work upon which he is employed.

The position which the engineer holds as to his employer and his contractor is without its parallel in the other professions, and his duties which arise thereunder to these parties are at once responsible and delicate. The engineer is quite generally made the only authoritative interpreter of the true intent and meaning of the plans and specifications; and the specifications more or less definitely provide that he shall determine every question, difference, or doubt, in relation to and arising from the work undertaken, and shall decide every question which may arise relative to the execution of the contract on the part of the contractor; that his estimates shall be held as final; and that his specific conclusions and decisions shall be beyond appeal.

These broad and conclusive powers would suggest that the engineer is an arbitrator between his principal and the contractor, and clothed with the fullest power of decision and action; and yet the analogy is not complete. An arbitrator should be a disinterested party, and such the engineer is not. An arbitrator should not be under the pay or influence of either party; the engineer is manifestly under both from his principal. An arbitrator should have no interest in the questions he is to decide; the engineer is called upon to support his intrepretations of his own plans and words, and to justify his estimates and conclusions generally. The position and its duties are anomalous, and a legal authority, commenting on the situation, said: "Under these conditions the contractor's rights depend upon his good luck in having his work under the supervision of an honest and conscientious engineer; and that the employer's obligations to pay or to perform depend upon his approval and the behavior of his engineer;" and that under such conditions "the courts undertake to guarantee the contractor that the employer or his engineer shall not capriciously nor unreasonably exercise his power to defeat the contract, or deny the contractor his just and reasonable compensation." No engineer has a right to force a reasonable contractor to carry into the courts the determination of questions that arise between them; for most contractors know that after resort to such an expedient their subsequent lot would not be a happy one; and that their position thereafter would be sadly prejudiced.

The apparent arbitrary power given to the engineer in the usual specifications and engineering contract, and which are probably generally conceded by the contractor, have their limitations in practice. Numerous decisions of the courts stamp with disapproval contract stipulations which tend to bind parties, before the occurrence of an event, to the arbitrary reference of matters arising from such events to an arbitrator without judicial functions. Neither have the courts regarded with favor the attempts of parties to oust their jurisdiction through unqualified agreements for arbitration. It should not be forgotten that all agreements for arbitration are revocable by either party at any time before the decision has been rendered by the arbitrator. This further indicates the attitude of the law toward arbitration. A very recent case decided by Judge Lawrence, of the New York Supreme Court, well illustrates this subject. Under a contract it was provided that, to prevent all disputes and litigations, it was agreed between the parties to the contract that the engineer should determine all questions of difference, and was to fix the amount and quality of the work to be done; and that the findings, estimates, and decisions of the engineer were to be final and conclusive. The court held that this provision in the contract was clearly to make the engineer the absolute and final arbiter as to all questions arising between the parties; that the provisions in question, if made operative, would oust the courts of jurisdiction; and, therefore, it was decided as being void on the ground of being adverse to public policy. This decision is in harmony with well-established judicial maxims and conclusions, and is supported by a long line of decisions.

Through the very powers which are, of necessity, given to the engineer, he owes a duty to his contractor and to his employees to treat all situations and conditions which may arise with judicial fairness; and while entitled to insist upon the full and proper carrying into effect of the work undertaken, he should not forget that his contractor holds rights which honesty and justice demand shall receive fair recognition. To fully meet the requirements of such a situation and its duties bespeaks for the engineer the admirable traits which we believe are an accompaniment to the profession under its best development.

Contrast such a view of the duties of an engineer to his contractor or his employees with the following as set forth in a text-book intended for the use of the profession: "The engineer is in the interests of the proprietor, and receives his compensation from him. * * * He is not required nor expected to watch the contractor's business, nor to promote his interests, and any attempt to do so might render his position untenable, change the relations of the parties, and render the stipulation of his choice invalid." Again, the same writer states: "The engineer owes no duties to the contractor except what he can demand by the terms of his contracts; he is under no obligations to protect his interests or assist him in his affairs." I should be sorry indeed to believe that such a doctrine could be held by the engineer who dignifies his profession and its duties, and who believes that these duties have their foundation in honesty, intelligence, and justice.

Electrical Income and Outputs per Ton of Coal.

[By Mr. Alton D. Adams, in *Elec. World.*]

Coal is the raw material and electrical energy the finished product of generating stations. In every system of electrical supply the problem is to deliver energy from the boiler furnace at the station to the lamps, motors, heaters and chemical vats of consumers. The general conditions are that heat must be changed to motion, motion to electrical energy, and this energy transmitted to the points of use. Notwithstanding the uniformity of these requirements, there are very few lines of manufacture in which such great variations are to be found between the quantities of raw material consumed and the product. Unfortunately these variations are too often overlooked because the data necessary to establish their existence is not readily available. Massachusetts alone among the States causes comprehensive data concerning the operations of electrical systems within its limits to be collected and published. The figures here presented as to the incomes, outputs and coal consumption of electric stations are derived from the report of the Gas and Electric Light Commissioners of that State, for the fiscal year ending June 30, 1900. Data is given for stations in cities only, and each station is designated by the name of the city in which it is located.

No city in the State except Boston contains more than one complete plant for public electrical supply. Figures are given for the 2 largest electrical systems in Boston. These systems have been consolidated since the issue of the latest report. All of the stations here considered are operated exclusively by steam power. For convenience of comparison, the stations are arranged in an order corresponding to the amount of coal burned during the year by each. The income per ton of coal for each station is determined by a division of the total income from the sale of electrical energy by the number representing the tons of coal consumed. Tons of coal here stated are long tons of 2,240 pounds each. Where screenings have been used, 85 per cent. of their weight are taken as the equivalent weight of coal. Coke has been used to a small extent, and its weight in the original reports is given in short tons of 2,000 pounds each. These weights for coke have been

Tons of Coal burned by Electric Lighting Stations, and the Income per ton from sales of Electrical energy for the year ending June 30, 1900.

Location of Station.	Tons of Coal Burned	Income Per Ton.
Boston—Edison	38,783.7	$28.75
Boston—Electric	28,746.0	31.24
Lowell	7,234.0	21.90
Cambridge	6,385.0	24.59
Pittsfield	6,302.0	12.75
Fall River	5,953.0	29.00
Worcester	4,877.0	44.40
Somerville	4,719.9	22.07
Lynn	4,627.0	32.69
Salem	4,403.0	22.19
Brockton	3,754.2	19.61
Chelsea	3,528.0	17.32
Newton	3,520.1	19.39
Waltham	3,392.2	14.64
North Adams	3,348.9	15.12
Woburn	3,084.0	18.62
Malden	2,961.4	44.67
Haverhill	2,277.6	30.61
New Bedford	2,209.0	47.65
Fitchburg	2,004.0	29.81
Northampton	1,974.0	18.46
Quincy	1,352.3	29 24
Gloucester	988.7	40.28
Beverly	773.2	36.50
Marlboro	656.3	36.50
Newburyport	518.0	33.10

added to those of coal without allowance for the short ton, on the assumption that coke is usually a more effective fuel than soft coal.

In a comprehensive view of the data for these 26 systems, the most striking fact to be noted is the great variation in incomes per ton of coal burned. Illustrations of the extremes of this variation are found at New Bedford and Pittsfield. In New Bedford the electric station earns an income of $47.65 for each ton of coal it burns, while the station at Pittsfield receives an income of only $12.75, or 27 per cent. of the former amount, per ton.

Even among stations that consume nearly equal amounts of coal there are wide differences between the incomes per ton. Take for illustration the stations at Worcester and Somerville, consuming 4,877 and 4,719.9 tons of coal respectively. At Worcester the income is $44.40 per ton, or twice the $22.07 received at Somerville. Equally good illustrations of the differences in incomes for plants that consume nearly equal amounts of coal may be seen in Cambridge and Pittsfield, and in Malden and Woburn. On the other hand, stations of widely different capacities often derive nearly equal incomes per ton of coal. Thus the Newburyport station, that consumed only 518 tons of coal, got an income per ton that was a trifle greater than the like amount received by the station at Boston, that consumed 28,746 tons, or more than 50 times as much. Similar equality of incomes per ton of coal burned by stations of widely different capacities may be observed in the Boston Edison station and that at Quincy, in Fitchburg and Fall River, and in a number of other cities included by the table.

The income per pound of coal burned is obviously a factor of great importance in the determination of net earnings for an electric system It is, therefore, a matter of no small practical interest to determine whether the very low earnings per ton of coal displayed by many stations are the best that can be had. The suggestion may at once be made that as the incomes of electric systems depend directly on the prices they are able to obtain for energy, the small earnings per ton of coal are simply due to poor markets. If this view of the case is in the main a correct one, there is little more to be said, and the station with a large coal bill and a small contract must be left to its fate. On the other hand, if it can be shown that in most cases a low income per ton of coal is the result of inefficient operation, a little good engineering may greatly improve matters.

It is just at this point that the student of operations by American electric stations meets the greatest difficulties. The amount of coal yearly burned is usually secret, the prices at which energy is sold are more secret, and the number of kilowatt hours delivered is most secret. Happily for the present inquiry, it is possible to determine from the Massachusetts reports not only the total amounts of coal consumed but also, by calculation, the prices at which large parts of the station outputs were sold, and the numbers of kilowatt hours in these parts.

Street lighting is that part of the services performed by electric systems whose price and amount in kilowatt hours can be accurately determined from the reports. The importance of this information obviously depends to a large extent on the ratio of street lighting to the total amount of service performed by each electric system. Not only the kilowatt hours supplied for street lighting and the price in each place has accordingly been calculated, but also the ratio of the income from street lighting to the total.

In order to draw fair conclusions as to the efficiency of electric systems from the prices for street lighting, it is desirable to determine whether such prices are generally higher or lower than those received for commercial service. As street lighting is usually the largest single contract on which an electric system is engaged, and as this service constitutes a more uniform load than any other, it seems at first glance that the rates charged for it should be lower than most others. On the other hand, the amount of street lighting to be done in any one city changes very slowly, while there is opportunity for great expansion in the direction of commercial service. Moreover, after a plant has reached a considerable capacity additional load may be taken on at a comparatively small expense of operation. These considerations, and certain facts as to particular plants that cannot be stated here, lead to the conclusion that average rates for commercial service are not usually far from those charged in street lighting. On this assumption it is easy to determine whether the wide variations in incomes per ton of coal burned are due to low rates for energy, or to poor efficiency. It is obvious that any errors, due to the assumption that average commercial rates equal the rates for street lighting, will be of less importance the larger the ratio of income street lighting to the total energy income. For this reason comparisons should be limited to stations that derive a large share, say, one-third at least, of their energy income from street lighting.

The ratio of income from street lighting to total energy income was at Worcester 34.6, and at Somerville 46.4 per cent. At the Somerville

Location of Station.	Kilowatt Hours to Street Lamps.	Cents per Kilowatt Hour.	Per Cent. Street Lighting to Total.
Boston-Electric	4,841,625.6	6.66	35.9
Worcester	1,233,021.1	6.09	34.6
Fall River	1,276,508.2	6.53	48.6
Lowell	956,304.9	6.00	36.2
Cambridge	837,348.8	7.81	41.6
Lynn	868,747.3	6.00	34.4
New Bedford	352,949.6	7.07	23.7
Somerville	532,885.3	9.08	46.4
Brockton	323,400.9	7.92	34.8
Haverhill	331,072.4	6.75	32.1
Salem	635,065.4	6.32	41.1
Chelsea	337,175.5	8.07	44.8
Malden	336,742.8	8.61	21.9
Newton	399,868.3	8.18	47.9
Fitchburg	307,975.1	9.71	50.1
Gloucester	100,876.6	12.80	32.4
North Adams	188,224.9	8.00	29.7
Waltham	112,204.0	11.86	26.8
Quincy	99,832.6	14.49	36.6
Pittsfield	132,816.5	10.26	16.9
Northampton	77,118.6	15.70	33.2
Newburyport	73,814.5	15.28	65.8
Woburn	76,007.7	13.91	18.4
Beverly	159,980.7	10.20	57.8
Marlboro	80,739.4	10.27	34.5

station the income per ton of coal was $22.07, and at Worcester the like income was $44.40. The price per kilowatt hour for street lighting was 6.09 cents in Worcester, and 9.08 cents, or about 50 per cent. greater in Somerville. On the reasonable assumption that average commercial rates correspond to those paid for street lighting in these two cities, the Somerville station must have earned about $66 per ton of coal burned, if the efficiency of operation had equaled that at Worcester. As the fact is that only one-third of this last amount was earned at Somerville per ton of coal, it follows that the consumption of coal there per unit of output was three times as great as that at Worcester. At Lynn 34.4 per cent. and at Northampton 33.2 per cent. of the entire energy income was derived from street lighting. The rate at Lynn was 6 cents per kilowatt hour for energy in street lamps, and at Northampton 15.70 cents. Each ton of coal burned at the Worcester station earned $44.40, so with equal efficiency the station at Northampton would have earned more than $110 per ton, if commercial rates were equal to those for street lighting. As only $18.46 per ton of coal was actually earned by the station at Northampton, its efficiency was only one-sixth of that of the Worcester plant.

It may be thought that quite small plants cannot approach the much larger ones in efficiency, but the facts show that such is not the case. At Beverly the electric plant got 10.2 cents per kilowatt hour for street lighting and 57.8 per cent. of its income was from this source. The Cambridge plant received 7.81 cents per kilowatt hour for its service to street lamps, and earned 41.6 per cent. of its income in this way. At

Cambridge the income per ton of coal burned was $24.59. As the price in Beverly was 1.3 times that in Cambridge for street lighting, if this difference in prices extended to the entire outputs, the income at the Beverly station should have been $31.96 per ton of coal, with equal efficiency in both plants. But the Beverly plant actually earned $36.50 per ton of coal, so that its efficiency was 14 per cent. greater than that at the Cambridge plant. The Cambridge system, however, supplied 837,348.8 kilowatt hours to street lamps, or more than five times the 159,980.7 kilowatt hours furnished for a like purpose by the plant at Beverly. In the matter of coal the Cambridge consumed eight times as much as the Beverly plant.

To bring out more clearly the differences in efficiency that exists among electric systems, it is desirable to get the results of each in pounds of coal consumed per kilowatt hour of output. With the assumption previously made, that commercial rates are the same as those for street lighting in systems where the income from the latter source is at least one-third of the total amount received for energy, the pounds of coal per kilowatt hour of total output may be calculated. Where the average price per kilowatt hour is the same for commercial service as for street lighting, the kilowatt hours supplied to street lamps must be the same per cent. of the total energy output that the income from street lighting is of the total energy income. In each case, therefore, the number of kilowatt hours supplied to street lamps is divided by the per cent. of income from street lighting to the total income, to determine the entire number of kilowatt hours in the output. The number of tons of coal as previously given for each station is multiplied by 2,240 to reduce it to pounds. This last amount is then divided by the number representing the entire output in kilowatt hours, and the result is the number of pounds of coal burned per kilowatt hour. All of the stations that derived one-third or more of their income from street lighting have been included in this process. The results are remarkable for the wide range of efficiency which they exhibit. The station at Worcester consumed only 3.1 pounds of coal per kilowatt hour of output, while that at Northampton used 19.3 pounds for an equal result. According to these figures the system at Boston, though having an output more than four times as great as that at Worcester, the next largest, is surpassed in efficiency by the systems of Worcester and Lynn. The most valuable of these results, because the least liable to error, are those for systems at Fall River, Somerville, Newton, Fitchburg, Newburyport and Beverly, in which the ratio of income from street lighting to total energy income

Location of System.	Total Kilowatt Hours for all Service.	Pounds Coal per Kilowatt Hour.
Boston-Electric	13,486,422	4.7
Worcester	3,563,644	3.1
Fall River	2,626,560	5.1
Lowell	2,641,726	6.1
Cambridge	2,012,867	7.2
Lynn	2,525,428	4.1
Somerville	1,148,459	9.2
Brockton	929,312	9.1
Salem	1,545,171	6.3
Chelsea	752,624	10.5
Newton	820,182	9.6
Fitchburg	614,706	7.3
Quincy	272,766	11.1
Northampton	232,284	19.0
Beverly	276,783	6.2
Newburyport	112,180	10.3
Marlboro	234,027	6.2

ranges from 46.4 to 65.8 per cent. At Fall River the consumption of coal was 5.1 pounds, and at Newburyport 10.3 pounds per kilowatt hour, a difference of 100 per cent. If the average commercial rate in any case is greater than that for street lighting, the computed number of total kilowatt hours for the year will be too great, and the pounds of coal per kilowatt hour in the table too small. To show the probable limits of error in the figures for pounds of coal per kilowatt hour, assume that in any case the average rates for commercial service is $1\frac{1}{2}$ times as great as the rate for street lighting, when the street lighting furnishes one-half of the total energy income. Then the true figures for total kilowatt hours will be $(\frac{1}{2} + \frac{1}{2} \times \frac{2}{3}) = 5.6$ of that given in the table, and the pounds of coal per kilowatt hour will be $1 \div 5.6 = 1\frac{1}{2}$ times the amount given.

With all possible allowances for error it is plain that the stations considered present variations of efficiency that can only be accounted for by poor engineering in some of them.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the Lansing (Mich.) Gas Light Company have purchased a site, at the foot of Pine street adjoining Willow street, whereon they propose to construct a modern works within the next 2 years. It is more than probable that the holder will be put up next summer.

THE Rockingham County Light and Power Company, which is the successor to the trading of the Portsmouth (N. H.) Gas, Electric Light and Power Company, has perfected the following organization: Directors, C. H. Tenney, W. D. Lovell, F. P. Royce, A. E. McRees, A. B. Tenney, A. M. Hyatt and H. M. Whipple; President, C. H. Tenney; Vice-President, W. D. Lovell; Treasurer, F. P. Royce; Secretary, A. B. Tenney; Superintendent, D. F. Burritt.

THE business of the Plainfield (N. J.) Gas and Electric Light Company has reached such a point that increased generating capacity had to be provided for. Accordingly a contract has been awarded to the United Gas Improvement Company for the installing of a set of its standard, double superheater Lowe water gas apparatus, up to a capacity of about 400,000 cubic feet per diem.

WE are in receipt of "Circular No. 65," recently issued by the Jeffrey Manufacturing Company, of Columbus, O., which puts before the reader in concise way an illustrated description of several of the novelties that are being sent out from its well equipped shops.

MR. FRANK W. FRUEAUFF, Secretary of the Denver (Col.) Gas and Electric Company, writing to us under date of the 12th inst., says:

To the Editors AMERICAN GAS LIGHT JOURNAL: The inclosed letter shows the interest that is being taken by people throughout the great State of Colorado in the subject of cooking. We are advertising free lessons in cooking at our office, and this letter comes from a town 200 miles from Denver; and yet they say gas companies are not public benefactors!

THE letter referred to by Mr. Frueauff was written by a woman who resides in Walsenburg, Col. She asked for information as to terms, length of time, and to know when she could come to Denver to take part in the course. The Denver Company evidently is spreading its light far and wide.

THE recent developments in the Texas oil fields have induced the Galveston (Tex.) Gas Company to seriously consider the matter of the manufacture of water gas. In fact the Galveston folks have awarded a contract to the United Gas Improvement Company for a set of its standard, double superheater water gas apparatus of a daily capacity of about 250,000 cubic feet.

MESSRS. W. A. THOMPSON and W. J. McDonald, of Chicago, and H. W. McCoy, of Peoria, Ills., have secured control of the Marquette (Mich.) Gas Light Company. They propose to reconstruct the works.

THE Criterion Gas Stove Company, of New York city, will establish a plant in New Brunswick, N. J. The factory will be in the buildings formerly occupied by the New Brunswick Foundry Company.

THE Lockport (N. Y.) Gas and Electric Light Company has filed against the State a claim amounting to $1,000 for land taken for canal improvement purposes.

MESSRS. DEILY & Fowler, of Philadelphia, are to construct a storage holder, to rest in a steel tank, for the Waynesboro (Pa.) Gas Light Company. The business of the Company has considerably more than doubled since its reorganization about two years ago.

RAILWAY coaches to the number of 105,664 are being lighted by means of Pintsch gas at the present time in America.

THE Nashville (Tenn.) Coke and Gas Company, with an authorized capital of $5,000,000, has been formed. The nominal incorporators are Messrs. Wm. A. Jones, Joseph B. Short and Melville A. Carpenter. The first named is a lawer and it is quite certain that none of the incorporators stated can be considered principals in the Company.

MESSRS. R. D. WOOD & CO., of Philadelphia, will build the new holder for the Milton (Pa.) Gas Company.

UNLESS all fair signs fail it may be put down as a fact that when the reorganization of the Lincoln (Neb.) Company is eventually completed—it is virtually at that stage now—Mr. H. L. Doherty will be its next President.

THE Bridgeport (Conn.) Gas Light Company, which now controls the business of the Citizens Gas Company, of Bridgeport, has notified the residents that the manufacture of a distinctively fuel gas will not be continued after January 1st. The Company further declares that it will either remove the fuel gas devices now installed in the houses of consumers or will alter the same to meet the requirements for the use of illuminating gas as fuel, according to the desires of the consumers.

ADVICES from Philadelphia dated the 16th inst., are to the effect that the November Grand Jury of that city returned 16 true bills of indictment against George M. MacClemmy charging him with murder and manslaughter. The case traces back to the explosion last August at 10th and Locust streets, whereby 8 persons lost their lives and a number of buildings were wrecked. MacClemmy kept a grocery store on Locust street, and it is charged that the explosion occurred on his premises through his having kept thereon a quantity of gasoline in excess of that permitted by the law.

THE Committee on Lights of the Portland (Me.) Board of Aldermen has decided to recommend the making of a contract with the Portland Gas Light Company whereby the latter is to maintain 335 Welsbach lamps for street lighting. The rate agreed on is $28.80 per lamp per annum.

AT a recent meeting of the Holyoke (Mass.) Scientific Association an interesting address was delivered by Mr. W. H. Snow, Superintendent of the Holyoke Gas Works. His subject was "Commercial Gas," and he put the subject in a practical, commonsense way that held the close attention of his audience to the end. The lecture was illustrated by lantern slides, the manipulator of the slides being Prof. J. T. Draper, of the Holyoke High School.

THE Olean Gas Mantle Company, of Olean, N. Y., has been organized. The Company proposes to manufacture a mantle that is to be known to fame under the trademark of "Empire."

THE old Bethlehem and South Bethlehem plants of the Wyandotte Gas Light Company of Bethlehem, Pa., are out of commission, the Company having started up its new plant which is located on Lehigh avenue next the tracks of the Central Railroad.

THE General Gas Light Company, of Kalamazoo, Mich., which manufactures the Humphrey Gas Arc Light, is erecting a commodious factory at the corner of Church and Water streets, Kalamazoo.

IN the reorganization of the Board of Trustees of the Wheeling (W. Va.) Municipal Gas Works the following appointments were made: General Superintendent, Frank F. Thompson; Secretary, W. W. Schenck; Assistant Secretary, B. A. Schuler; Collector, L. F. Seabright.

AT the annual meeting of the shareholders in the Elizabethtown Gas Light Company, of Elizabeth, N. J., the following Directors were elected: John Kean, Julian H. Kean, Hamilton F. Kean, James Maguire and Alexander Kean.

THE Cincinnati *Enquirer* recently said that the business of the Cincinnati Gas and Electric Company is increasing at a rate "that has never before been equaled in its history." And the *Enquirer* also said that the main increase was traceable to the gas division of the Company's trading.

THE matter of awarding a franchise for the supplying of gas to the people of Harvey, Ills., remains unsettled. The promoters of the Harvey Water and Light Company seem to be regarded with the most favor, but the partisans of the Geiss syndicate insist that their side must win in the end. The Company offers to give "the city" $700 in cash when the ordinance is passed, and $2,000 more when it is accepted; and the Geiss party offer to give $1,000 "as a totality."

THE new proprietors of the Petersburg (Va.) Gas Company have put out something like $20,000 in plant betterments since they took possession and they have the satisfaction of knowing that the money was not spent without purpose, for the increase in output is averaging something better than 15 per cent.

MR. JOSEPH CLARK, of Peoria, Ills, Vice-President of the Consumers Gas Company, of Charleston, Ills., is our authority for the statement that the plant will be in operation within 4 months.

THE City Council of Brazil, Ind., has granted to Messrs. W. M. Eaton and H. H. Page, of Jackson, Mich., a franchise for the operating of a gas plant. They say they will begin work at once. The franchise is to run for 50 years, and it is estimated that the cost of the works complete will not be far from $75,000. If we are not in error, Mr. Page has extensive business interests in Brazil.

THE gas works of the Sterling (Ills.) Gas and Electric Light Company are to be rebuilt. The reconstruction scheme also includes an extension of the main system.

PRESIDENT ADAMSON, of the Manchester (Va.) Gas Company, reports that 100 customers are on its books, and that the use of gas for fuel purposes is commencing to appeal practically to the housekeepers.

THE Washington (D. C,) Gas Light Company has made an important addition to its real estate holdings through the purchase of a lot on E street between 9th and 10th streets. This, of course, is in connection with the plot on which its office building is located.

THE Directors of the St. Paul (Minn.) Gas Light Company have voted to pass the usual quarterly dividend. The rate was 4 per cent. per annum. In explanation of this action the Directors declared that the money on hand should be devoted to assisting in defraying the extraordinary expenses incurred within the last few months "in building a large addition to the Cedar street power station and in laying an extensive system of underground cables and conduits."

THE time for the final taking over of the plant and franchise of the Auburn (N. Y.) Gas Light Company, by Mr. E. H. Palmer, of Geneva, N. Y., and his associates, is set for December 1st.

THE regular semi-annual dividend of 2½ per cent. on the preferred stock of the Laclede Gas Company of St. Louis, Mo., is payable December 16th.

BY Mr. Bankson Taylor, Proprietor of *Gas*, New Orleans, La.: "Gas Jet.—Hello, candle; you seem to stick to your job all right!" *Candle.*—"Yes; I can't escape!"

THE general offices of the many gas companies controlled by the syndicate headed by Mr. William T. Morris, of Penn Yan, N. Y., will be removed from Penn Yan to Ithaca, N. Y.

ANNOUNCEMENT was recently made of the incorporation of the National Coke and Gas Company, at Trenton, N. J., by Messrs. William A. Jones, Joseph B. Shott and Melville Carpenter, of Newark, N. J. The concern is capitalized in $5,000,000, and we understand that it proposes to manufacture coke and gas "in and around Newark."

THE following is from the Boston (Mass.) *Globe*, dated Nov. 16th: "The members of the State Board of Gas and Electric Light Commissioners are once more at odds. An important decision issued yesterday, in relation to the petition of the Mayor and citizens of Quincy, for a reduction in the price of gas charged by the Citizens Gas Light Company, and also for an extension of the Company's mains into the newer systems of the city, brought to light strong differences of opinion." Perhaps the *Globe* is right in the assertion that "strong differences of opinion" existed in the Commission over the subject, but the plain facts of the case as found in the opinions of the Commissioners are these: Chairman Barker and Commissioner Gifford declare that no occasion for the ordering of a reduction in the selling rate exists; Commissioner Schaff declares that a cut of 15 cents would be about the right thing. In the matter of ordering an extension of the gas mains, Chairman Barker and Commissioners Gifford and Schaff *agree* in the negative. In the light of which report where can one see the existence of "strong differences of opinion?"

MR. JOHN E. O'BRIEN, Manager of the Atlas Pipe Wrench Company, writes that his Company is a believer in expositions, in that its sales show a wonderful increase in the last few months, much of which activity he asserts is due directly to the exhibit made by the Company at the recent Pan-American Exposition at Buffalo, N. Y.

WE understand that the New England Gas and Coke Company is again supplying gas from its Everett works to the Companies in and around Boston, which are supposed to be owned or controlled by Mr. Edward Addicks and his associates.

Electricity says that a local electrician and proprietor of a store, which carries a stock of electric supplies and fixtures, in Madison, Wis., has been getting cheap electric lighting. His scheme was to dodge the meter. In an out-of-the-way place back of the meter he "cut in" what is known as a "jump drive." This diverted the electric current and carried it around the meter, where the wire was again attached to the lights. By means of a button he was able to control things so as to allow enough current to pass through the meter so that his bill would amount to something each month. His increasing economy in light finally aroused suspicion, and an investigation resulted in the discovery of his scheme.

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Notification Respecting Advertising.—Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

MONDAY, NOVEMBER 25, 1901.

The Market for Gas Securities.

Some animation was shown in the trading in local gas securities during the week, a spurt in Consolidated, that culminated Thursday noon, bringing the price to something over 224. The closing to-day (Friday) was made at 221 to 222. There is nothing of moment to chronicle in connection with the situation, although many say that the dickering in respect of the Brooklyn Union amalgamation with Consolidated is approaching the warm point. Looking the situation over, it is up to the Brooklyn concern to say whether it will lease, sell or build, for in another year's time it will have to build or stand for opposition. Its plants, over and underground, are even now altogether inadequate, and the consumers, who are the ones that pay, are loud in their protestations. The Consolidated dividend for the quarter will not be changed.

The nominal quotations for Brooklyn Union are unchanged. Peoples, of Chicago, has experienced a smart decline; but the same is attributable altogether to manipulation. Washington (D. C.) gas keeps on the upward way, and Buffalo (N. Y.) gas has surprised its friends by getting over 10. Secretary Babcock, of the American Gas Company, informs us that the regular semi-annual dividend of 3 per cent. on its shares is payable from the 1st prox.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

NOVEMBER 25.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	221	222
Central Union, Bonds, 5's.	3,000,000	1,000	109	110
Equitable Bonds, 6's	1,000,000	1,000	105	
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	295	305
" Bonds	1,500,000	1,000	00	102
Municipal Bonds	750,000	.	..	.
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	107	107½
Northern Union, Bonds, 5's.	1,250,000	1,000	106	108
New York and East River.. Bonds 1st 5's	3,500,000	1,000	111	115
" 1st Con. 5's	1,500,000		109	111
Richmond Co., S. I.	348,650	50	100	..
" Bonds	100,000	1,000	103	..
Standard	5,000,000	100	130	135
Preferred	5,000,000	100	150	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	118	..
Yonkers	299,650	500	120	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	213	215
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	⅞	1
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	95	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	11¼	11½
" " Bonds, 5's	5,250,000	1,000	80¾	81¾
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	20,500,000	100	104½	104¾
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	61¾	62
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	.	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12	14
" Con. Mtg. 5's	380,000	1,000	79	83
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50		89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	89	89½
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	..	.
" Bonds	2,000,000	..	53	55
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	102	104
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	60	66
" Bonds, 6's	2 650,000	..	99½	101½
Jackson Gas Co	250,000	50	67	70
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	92½	93¾
Preferred	2,500,000	100	101	.
Bonds	10,000,000	1,000	..	108½
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	48	55
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	102½	108
" 6 per cent. scrip, due 1910	100,000	25	87	89
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	.	..	103
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co.	1,000,000	100	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	97½	97⅝
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	46	46½
St. Paul Gas Light Co.	1,500,000	100	60	63
1st Mortgage 6's.	650,000	1,000	82	85
Extension, 6's.	600,000	1,000	.	..
General Mortgage, 5's	2,465,000	1,000	86	88
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	93	96
Syracuse, N. Y.	1,750,000	100	17	19
Bonds	1,612 000	1,000	91	93
Washington, D. C	2,600,000	20	327¾	330
First mortgage 6's	600,000	..	..	..
Western, Milwaukee. Bonds, 5's	4,000,000	..	107	108½
Wilmington, Del.	600,000	50	232	..

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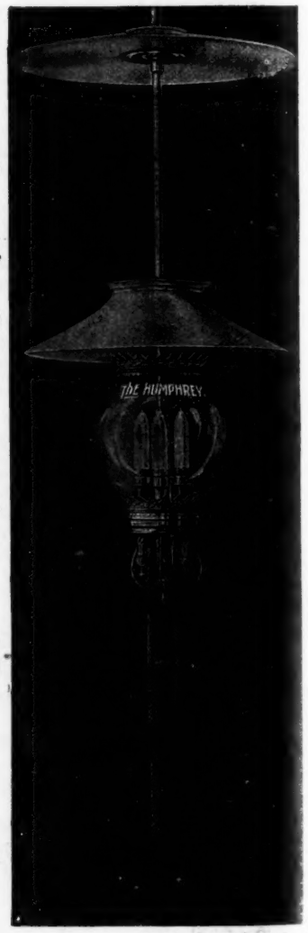

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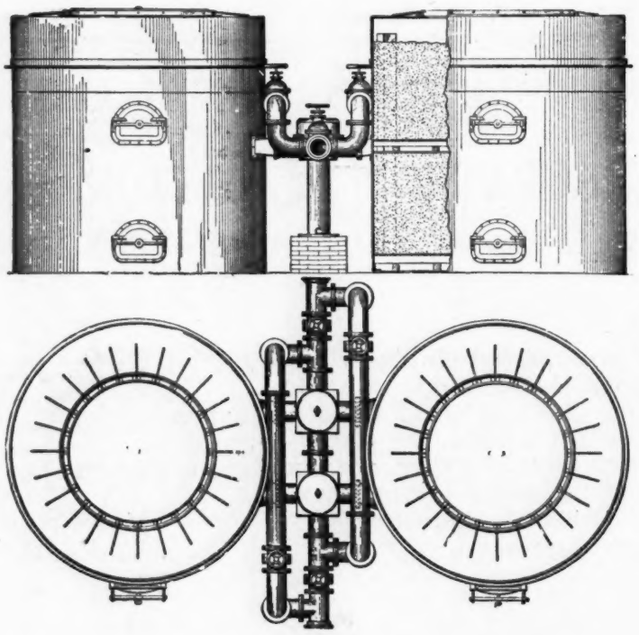

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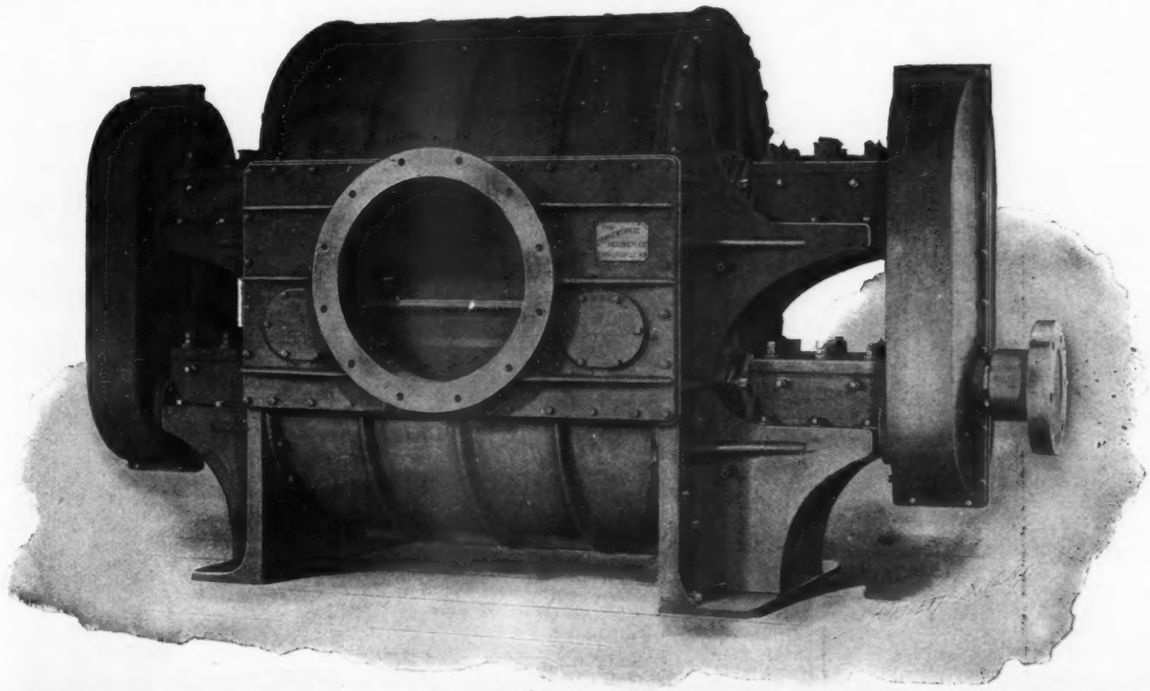

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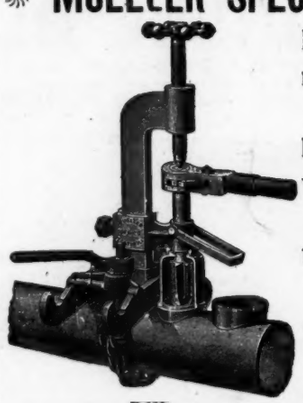

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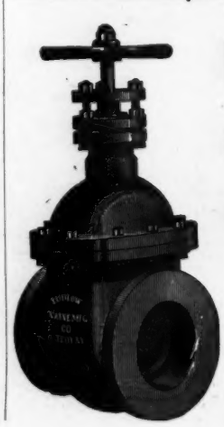

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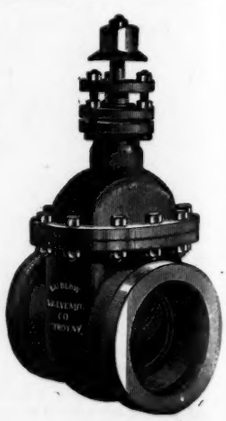

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STRICTLY HIGH-CLASS LAVA TIPS.

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Gas men everywhere admit the correctness of the Center Support, and have given ALAVA the highest indorsement. SUBSTANTIAL INDORSEMENT in the shape of orders. If you haven't done so already it will pay YOU to investigate. Send for our booklet entitled "Center Supports." : : : : : : : : : : :

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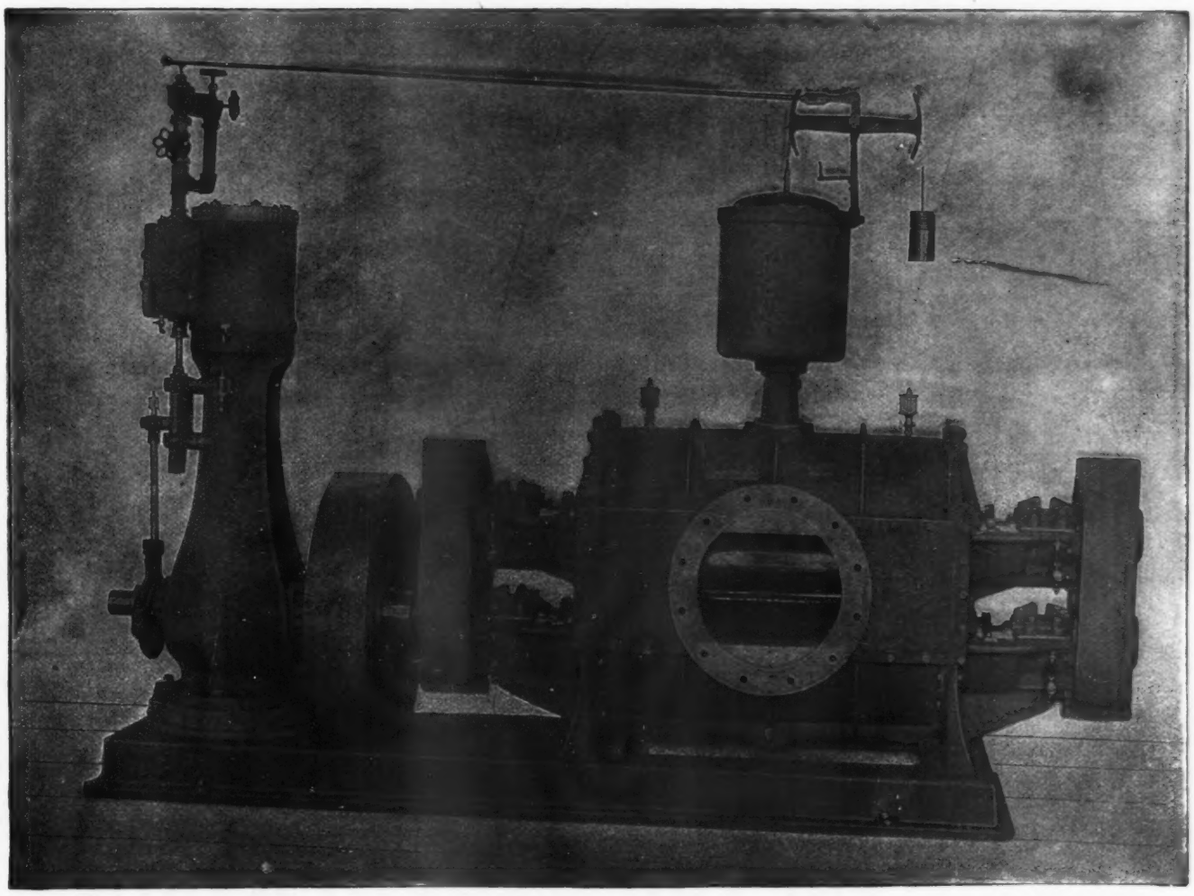

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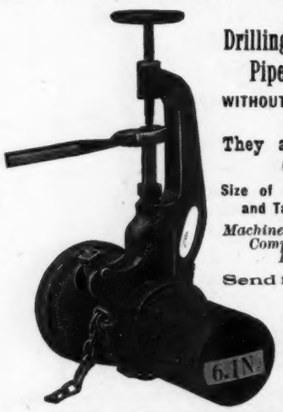

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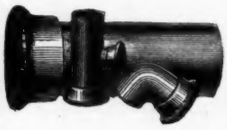

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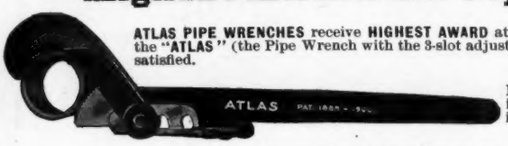

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FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

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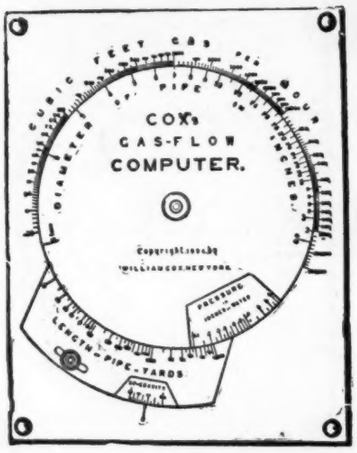

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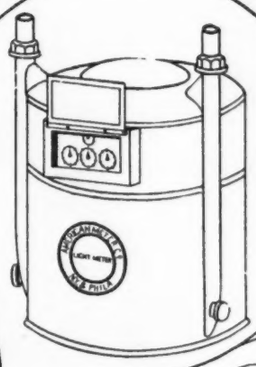

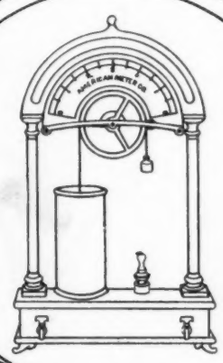

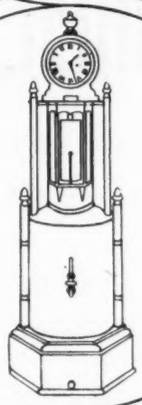

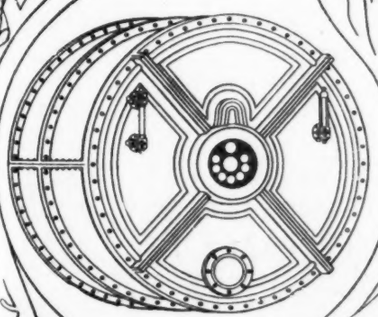

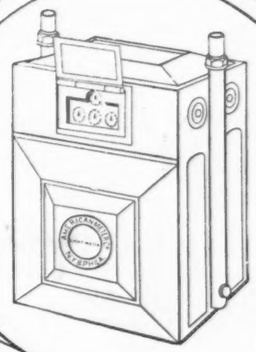

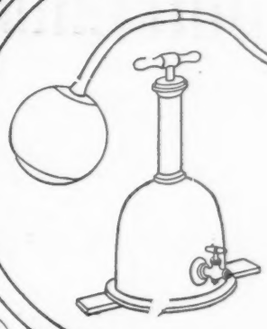

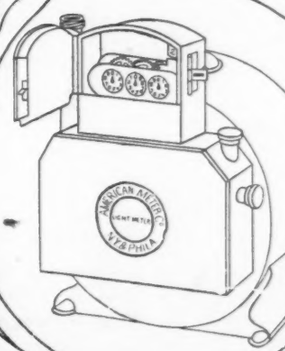

PUBLIC LIGHTING TABLE.

DECEMBER, 1901.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Sun.	1	5.00 PM	12.00 PM	4.20	6.10
Mon.	2	5.00 LQ	1.00 AM	4.20	6.10
Tue.	3	5.00	2.00	4.20	6.15
Wed.	4	5.00	3.00	4.20	6.15
Thu.	5	5.00	3.50	4.20	6.15
Fri.	6	5.00	4.50	4.20	6.15
Sat.	7	5.00	6.10	4.20	6.15
Sun.	8	5.00	6.10	4.20	6.15
Mon.	9	5.00	6.10	4.20	6.15
Tue.	10	5.00 NM	6.10	4.20	6.20
Wed.	11	5.00	6.10	4.20	6.20
Thu.	12	5.00	6.10	4.20	6.20
Fri.	13	5.00	6.10	4.20	6.20
Sat.	14	5.00	6.10	4.20	6.20
Sun.	15	8.10	6.20	4.20	6.20
Mon.	16	9.10	6.20	4.20	6.20
Tue.	17	10.20	6.20	4.20	6.20
Wed.	18	11.20 FQ	6.20	4.20	6.20
Thu.	19	12.30 AM	6.20	4.20	6.20
Fri.	20	1.40	6.20	4.20	6.20
Sat.	21	2.50	6.20	4.20	6.20
Sun.	22	4.00	6.20	4.20	6.20
Mon.	23	5.10	6.20	4.20	6.20
Tue.	24	No L.	No L.	4.20	6.25
Wed.	25	No L. FM	No L.	4.20	6.25
Thu.	26	No L.	No L.	4.20	6.25
Fri.	27	5.10 PM	8.30 PM	4.20	6.25
Sat.	28	5.10	9.40	4.20	6.25
Sun.	29	5.10	10.40	4.20	6.25
Mon.	30	5.10	11.50	4.20	6.25
Tue.	31	5.10	12.50 AM	4.20	6.25

TOTAL HOURS LIGHTING DURING 1901.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	220.10	January	423.20
February	192.30	February	355.25
March	180.00	March	355.35
April	158.30	April	298.50
May	140.40	May	264.50
June	135.40	June	234.25
July	138.00	July	243.45
August	156.20	August	280.25
September	174.40	September	321.15
October	202.30	October	374.30
November	220.40	November	401.40
December	241.30	December	433.45
Total, yr.	2161.10	Total, yr.	3987.45

NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

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.... OF AMERICA ....

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Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

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By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

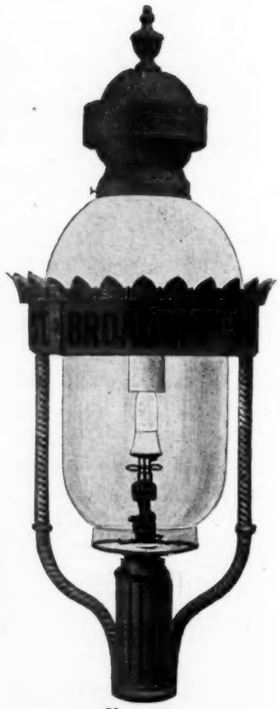
POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others Interested in Municipal and Outside Lighting.



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UNIVERSAL WELSBACH BURNER.

The most practical, efficient and artistic burner yet produced. . . . . .

It contains an improved adjustable Bunsen so constructed as to permit of a wide range of variations in gas pressure without blackening the mantles and without an adjustable air shutter. . .

It can be used with all styles and sizes of glassware, either shades or globes. No further necessity to carry a stock of different burners for the many sizes and shapes of glassware.

GAS COMPANIES AND DEALERS CANNOT FAIL TO APPRECIATE THE MANY SALABLE FEATURES OF THIS NEW BURNER.

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Salesrooms in all the Leading Cities of the United States.

THE STANDARD DOUBLE SUPERHEATER
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Under Contract, 1901:

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Total Daily Capacity, - - - - 28,200,000 Cubic Feet

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Standard Fire Brick and Gas Retorts.

ISAAC C. BAXTER, President.

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BENCH SETTINGS,

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GEROULD'S IMPROVED RETORT CEMENT

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In Kegs, 100 to 200 " " 6 " "
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Containing 6, 8 or 9 Retorts.

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Particularly a CONNELLY Gas Governor,

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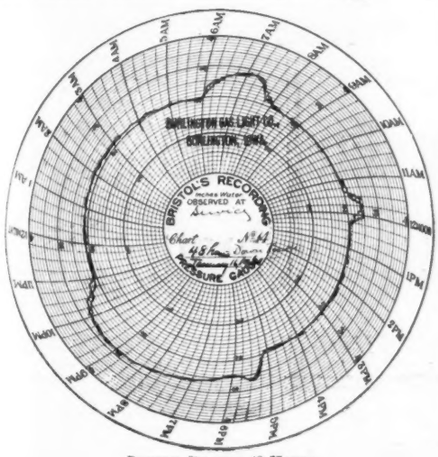

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Manhattan Fire Brick & Enameled Clay Retort Works,

Designers and Builders of Chimneys of Perforated Radial Bricks.

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Carefully prepared.
For Gas Making or
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Church's Patent Trays.

Reversible; Strongest; Most Easily Repaired.
Special Trays for Iron Sponge.

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We also Supply the Cheapest and Strongest
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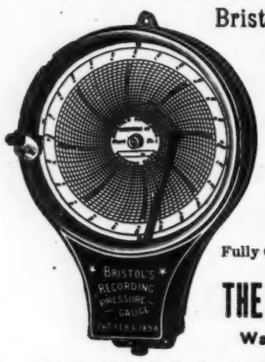

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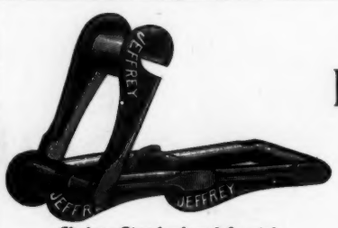

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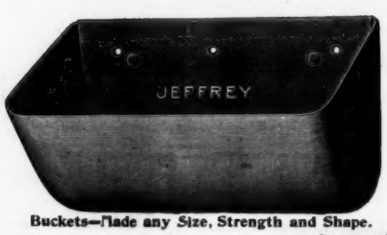

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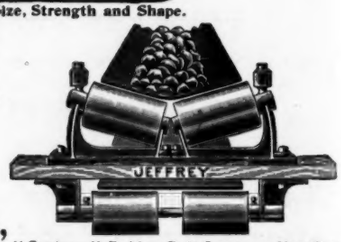

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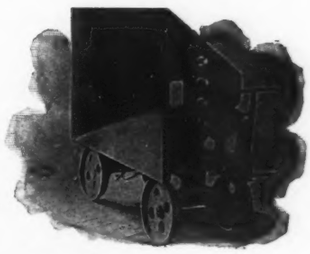

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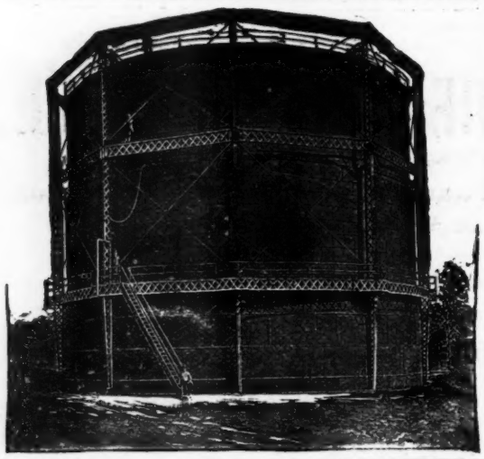

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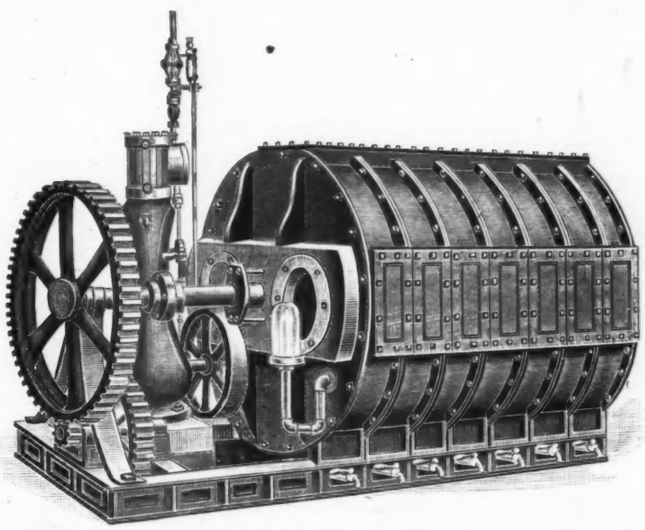

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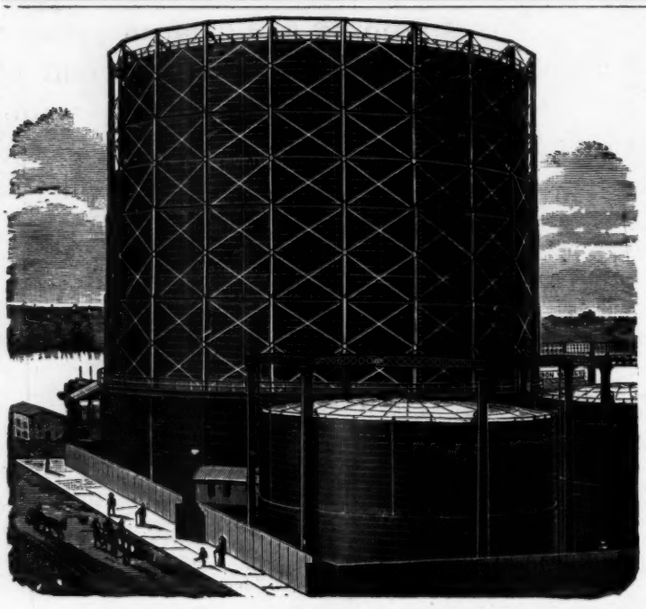

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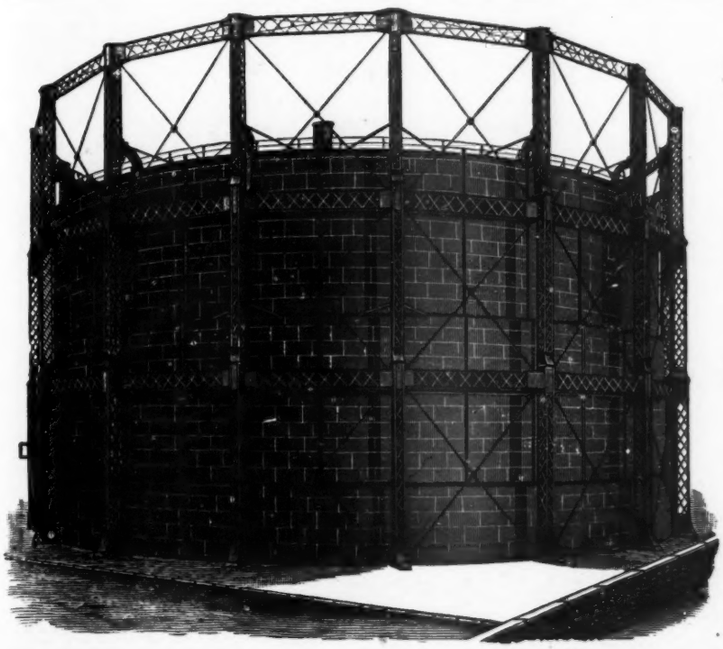

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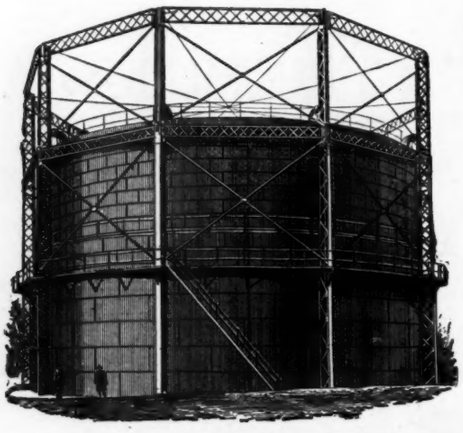

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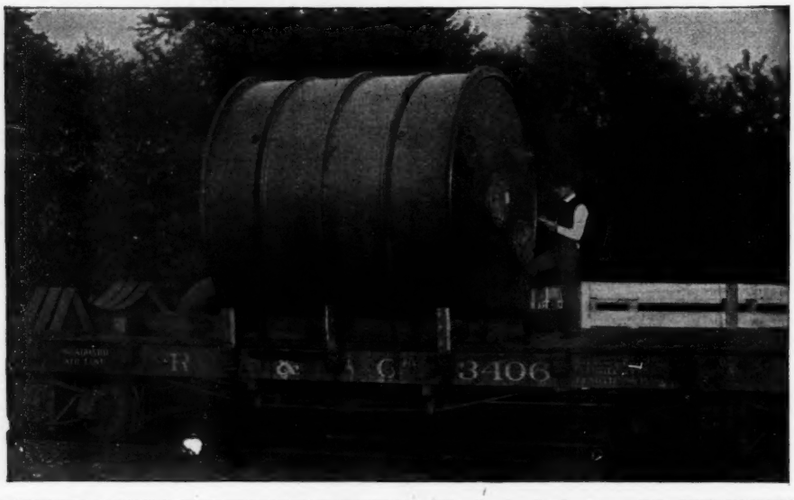

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